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ABSTRACT

This book contains eight chapters by several different authors, most of them professors of health or physical education. Focus is on applications and implications of programed instruction for professionals in the health and physical education fields. "Overview of Programed Instruction" defines programing, its development and implications for learning theory, and compares linear and branch programing. Chapter 2 on "Theory and Designs of Programs" is itself programed to illustrate the two common forms as well as behavioral objectives and self examination. "The Case for Programing" discusses uses of programed instruction, advantages and disadvantages, teacher role, and programed movement instruction (PMI). Chapter 4 deals with the "Format and Hardware of Programed Instruction," Chapter 5 with "Pioneering Programing Efforts" in health and physical education. Chapter 6, "Other Uses of Programing Theory," suggests application of the statement of objectives, evaluation, and feedback of results to other forms of instruction. "The Challenge of Programing to Teachers" lists specific steps to follow in writing a program. The final chapter is a summary focusing on implications of programed instruction for future research, students, and teachers. Authors are Mildred Barnes, Loren Bensley, Robert Clayton, Thomas Evaul, A. Bruce Frederick, Cyrus Mayshark, Einar A. Olsen, and Mary Ost. (JS)

PROGRAMED INSTRUCTION IN HEALTH EDUCATION AND PHYSICAL EDUCATION

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Preface

The phenomenon of programed instruction can no longer be denied. Since it burst upon the educational scene in the mid-1950's its impact has mushroomed to such a point that today it affects and involves *all* subjects in the curriculum including health education and physical education. Because professionals in both these fields must be cognizant of the *applications* and *implications* for them, this booklet has been developed to serve as a guide to programed instruction in health education and physical education.

Beginning in 1965 two groups, appointed independently of each other by the executive councils of the Health Education and Physical Education Divisions of the American Association for Health, Physical Education, and Recreation began work on programed booklets in their respective fields. It became apparent that there was duplication of effort and copy and that to continue in the direction of separate publications would not only be redundant but would also be wasteful of Association resources.

The chairmen, now serving as coeditors of this book, met to discuss a joining of forces. As a consequence of this exploratory meeting, a new tentative outline was developed, several writers were contacted for ideas, a final outline was agreed upon, assignments were made and accepted, and the completed manuscript was turned over to the Editorial Department of AAHPER in April 1969.

This has been a truly cooperative venture. Efforts have been combined to produce a booklet that strives to represent both health education and physical education. We hope that each profession will see it as an honest reflection not only of its separate interests and needs but also of those interests and needs common to both.

Editorial appreciation is extended to the several writers who took time from busy schedules to complete their tasks. The quality of their efforts and their vision of the total project are reflected in the fact that the several contributions melted together with little need for transitional material.

Any innovation in education (and certainly programed instruction is still in that category) deserves a full and fair hearing. If, after thorough study of the following material, the members of our professions are encouraged to develop, test, use, and finally to accept or reject programed instruction, this booklet will have served its purpose.

CYRUS MAYSHARK
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1

Overview of Programed Instruction

LOREN BENSLEY

Many studies concerning educational methodology have been reported in the past few years. It is through the development of these studies that ideas are tested and eventually conclusions drawn that will enrich our educational system. A large number of studies reported to date have arrived at the conclusion that teaching is most effective when it adjusts to the singular requirements of each learner. Educators of motor skills have long realized this concept. The teaching of a motor skill or, more generally, the development of an accomplished athlete has resulted from the interaction between one student and his coach. Ideal learning takes place in the type of teaching situation where a coach can make a complete analysis of his student and then design a program based on the student's strengths and weaknesses.

The teaching method just described is Utopian in nature and, unfortunately, has not become a reality in our educational system. In this day of large-scale education the absence of the individualization of student instruction is evident. Schools are confronted with mass media education where great numbers of students can be taught economically. As a result, the skills of the teacher and the individualization of student instruction are depleted or, at best, reduced to an average method.

Programing Defined

Psychologists and educators concerned about this present-day dilemma have been striving for a new and better method of instruction in which great numbers of students can be taught without the loss of student individualization. A new method, which is still in its neophyte stage, is programed instruction. This method tends to capitalize on student-teacher interaction and, at the same time, solve some of the problems of mass education. Most data gathered to date concerning programed instruction indicate a revelation in the learning of factual information. The techniques on which programed instruction is founded have been the foundation of teaching for centuries. These techniques combine the

Socratic method of teaching by asking questions and the Cartesian method of analyzing a problem into its smallest parts and proceeding from the simple to the complex. It also provides control over the teaching relationship by demanding interaction between the learner and the material to be learned. It does this by making appropriate use of rewards to reinforce correct responses. An additional factor is that it enables the slow as well as the fast student to move at his own rate of learning. In simple language, programed instruction provides the educational factors of teaching, testing, and corrective instruction.

Its acceptance on the educational scene has stimulated publishing companies to produce programs in practically every subject area. The excitement it has created can be felt in the elementary classroom, secondary schools and colleges, industry, the military, and in the home. It is regarded as the newest thing on the educational scene—newer even than educational television, team teaching, and green chalkboards.

The Development of Programing

Although the use of programed instruction in its present form is still in its infancy, it was used in essence by Socrates in teaching geometry. This was recorded by Plato in the dialogue *Meno*. It was Socrates' habit to guide his students' learning by conducting them conversationally along a path from fact to fact and insight. At periodic intervals along this path of learning, Socrates would ask his students questions to which they would respond. By so doing, this great teacher would always be alert to his students' progress. If he observed the students straying from the designed path, he would prompt or cut them so that they would again be guided in the right direction. When the students answered the questions correctly, reinforcement and praise were given. The similarity between this great educator's methods and the contemporary use of programing is easy to observe.

Another account of the theory of programed instruction is found in the work of Comenius who advocated teaching in small steps; no step being too great for the student who was about to learn it. This seventeenth-century teaching method was similar to that of Socrates. Many other great teachers, though possibly not as renowned, have used these methods which parallel the theory underlying programed instruction.

Later came the tutorial method practiced by colleges of the English universities and eventually adopted in various forms by a number of this country's institutions of higher learning. The continuous exchange of questions and answers between the teacher and the student, the unfolding of information and explanations, and the constant selection of new material on the basis of students' mastery of what has been learned is a forerunner of programed instruction.

No attempts were made to develop this method of teaching commercially until 1866 when Halyon Skinner was granted a patent for a spelling machine. In 1872, G. P. Putman and Sons carried in their catalogue an entire list of self-instruction materials. The next year W. S. Jevons developed a logic machine designed to solve logical problems symbolically. In 1915 Louise E. Ordahl and G. Ordahl developed an instrument to teach mentally retarded children. Three years later, during the First World War, H. B. English invented a device which provided visual feedback to help soldiers squeeze a rifle trigger.

More advanced development of the principles underlying programed instruction dates from the work of Sidney L. Pressey, a psychologist who in the early 1920's developed a testing device at Ohio State University. It was first introduced during the 1924 American Psychological Association meeting when Pressey presented a paper and showed how his multiple-choice testing and teaching machine operated.

Pressey's machine is considered the forerunner of present-day teaching machines. While this machine could produce measurable amounts of learning in students, its effect did not result in enthusiasm among educators or psychologists.

According to scholars, this situation may have been caused partially because: (a) times were not ripe for acceptance; (b) it was conceived primarily as a testing device and secondarily as a teaching machine; (c) they were working against a background of psychological theory which had not come to grips with the learning process. In 1932 Pressey discontinued his effort to place teaching machines in American classrooms. A statement he wrote at the time was heavy with disappointment and emotion:

> With a little money and engineering resources, a great deal could easily be done. The writer has found from bitter experience that one person alone can accomplish relatively little and he is regretfully dropping further work on these problems. But he hopes that enough may have been done to stimulate other workers, that this fascinating field may be developed.[1]

Although Pressey was disappointed with the progress of his ideas, he did stimulate interest in others that kept the spark of programed instruction alive. From time to time during the 1930's and 1940's, variations of Pressey's machines appeared, such as Peterson's chemo-cards in 1931 and Angell's punchboard in 1949.

The war years found an increasing number of experimental psychologists applying their concepts and techniques to military training. Since the military had the available funds and subjects, they were willing to attempt experiments with programed instruction and found them to be satisfactory in many areas.

The early 1950's found sporadic attempts at programing by Besnard, Briggs, and Walker, who developed for the Air Force several large multiple-choice devices for trouble-shooting.[2] Electronics trouble-shooting research has produced numerous other multiple-choice devices such as the tab test, trainer tester, automat, and many other devices which could provide reinforcement.

[1] Fine, Benjamin. *Teaching Machines.* New York: Sterling Pub. Co., Inc., 1962, p. 38.

[2] Besnard, G. G.; Briggs, L. J.; and Walker, E. S. "The Improved Subject Matter Trainer," Technical Memorandum. Colorado: Armament Systems Personnel Research Laboratory, Lowry Air Force Base, April 1955.

Although the work after Pressey was a contribution to the automated teaching movement, it was not until 1954 that a new interest was initiated by the work of B. F. Skinner at Harvard University. In his now famous paper "The Science of Learning and the Art of Teaching," presented in 1954, Skinner suggested the possibility of a more direct educational application of concepts developed in the experimental laboratory. He proposed that his experimental work on the analysis of behavior had direct implications for the teaching process, and that its application could be implemented by appropriate instrumentation. He pointed out the relationship to education of experimental laboratory work on the control and modification of behavior, and illustrated his ideas by a teaching device designed to present a carefully sequenced set of materials and reinforce a student's response at each step of the program.

Skinner emphasized the importance of reinforcement in programed instruction. "Once we have arranged the particular type of consequence called reinforcement," wrote Skinner in 1954, "our techniques permit us to shape the behavior of an organism at will." [3] He was speaking of his successful experiments in teaching rats and pigeons various skills by means of reinforcement. Convinced that humans could also learn successfully by this method, he devised a machine that could provide reinforcement.

Skinner's teaching machine differed from that of Pressey in that Skinner's machine permitted the student to construct his own answer, while the Pressey machine was on the order of a multiple-choice test. Unlike Pressey, Skinner designed his machine for the sole purpose of teaching.

Following the publication of his article in 1954, Skinner developed an intensive program at Harvard University to further explore his ideas. During this time he wrote a program, "Science and Human Behavior," which was used with a disk-type machine. This later was revised by J. G. Holland, one of Skinner's associates, and reported in 1959 at the Conference on Teaching Machines at the University of Pennsylvania.

In 1958 Douglas Porter built a similar device at Harvard that improved on Skinner's, inasmuch as it was more compact and economically more suitable for mass use. This same year Skinner wrote his second historical article, "Teaching Machines," that further elaborated on research undertaken at Harvard.

Other devices of greater simplicity were being developed at the University of Pittsburgh by J. L. Evans, Robert Glaser, and Lloyd E. Homme. They deleted the machine entirely from their concept of programed instruction but retained the most important feature—the program. Essentially, what they developed was a program in textbook form. This eliminated the machine that was necessary to present the program. The debut of the programed text as a teaching device established a foundation for further research and development of the art of programed instruction. Soon it became obvious that it was not the machine but the program that it contained that taught the material. Skinner himself

[3] Lysaught, Jerome P., and Williams, Clarence M. *A Guide to Programmed Instruction.* New York: John Wiley and Sons, 1963, p. 3.

admitted this in his 1958 article when he stated, "The Machine itself, of course, does not teach; it simply brings the student into contact with the person who composed the material it presents. . . .[4]

After Evans, Glaser, and Homme established the idea that the machine was not absolutely necessary for programed instruction, publishers began to explore the programed text as an answer for an inexpensive approach to establish programed instruction in the schools.

With the popularity of programed instruction, along with the availability of more programs, a multitude of studies appeared during the late 1950's and early 1960's. Wilbur Schramm describes this era when he states, "No method of instruction has ever come into use surrounded by so much research activity; indeed for a time it seemed that there would be more research than programs."[5] A review of the literature shows that these studies were concerned with what program people call presentation variables such as: prompting and confirmation, branching, pacing, size of step, and machine vs. text. About a third of the studies dealt with response modes such as overt vs. covert and multiple choice vs. constructed responses. Other experiments were concerned with evaluative tests comparing the amount of learning from programs with the amount of learning from conventional classroom teaching of the same subject. A few studies have been made with special applications of programs to slow learners, deaf and retarded children, and industrial trainees. It is interesting to note that only a handful of experiments made use of the "intrinsic" programing. More of this method is presented later in this chapter.

It soon became apparent that future educators should be introduced to this new educational technique. As a result of this demand, Jerome Lysaught and Clarence Williams introduced what may have been the first college-level course for teachers in programed instruction at the University of Rochester in 1961.

Since 1960 programed instruction has no longer been confined to the United States. Educators in Great Britain, France, Russia, Germany, Czechoslovakia, Sweden, and Japan have initiated research in the theories of programed instruction.

Today the field of programed instruction seems to have reached a place where the people involved are caught up in reexamination and evaluation of all that has gone before as well as the continuing task of considering all relevant conclusions and viewpoints. The field appears to be in the process of undergoing a period of intellectual incubation prior to some new major breakthroughs.

Implications for Learning Theory

As was pointed out previously, the theories that form the foundation of this method of learning are not new. Socrates and Comenius were

[4] Holland, J. G., and Skinner, B. F. *The Analysis of Behavior*. New York: McGraw-Hill Book Co., 1961.

[5] Schramm, Wilbur. *The Research on Programmed Instruction: An Annotated Bibliography*. Washington, D.C.: U.S. Government Printing Office, 1964, pp. 1-3.

advocates of characteristics that have made programing successful. Quintilian, two thousand years ago, had this advice for teachers: "Do not neglect the individual student. He should be questioned and praised. . . . He should strive for victory, yes, but it must be arranged that he gains it. In this way let us draw forth his powers with praise and rewards."

In 1912, Thorndike visioned the potential of what we now refer to as programed instruction when he wrote, "If, by a miracle of mechanical ingenuity, a book could be so arranged that only to him who had done what was directed on page one, would page two become visible, and so on, much that now requires personal instruction could be managed by print.[6]

Thus, some of the great teachers and thinkers unknowingly practiced the art of programed instruction. Before progressing any further, it would seem logical to establish an understanding of what these educational and psychological theories were. Many people compare a program with a textbook; however, a program requires more from the student than a textbook. A program is text-constructed to be almost error free, thus permitting the student to make only correct responses which can be immediately reinforced. Guthrie is also a proponent of correct responses and suggests that learning the association of stimuli and responses occurs as soon as a response is made, not when reinforcement occurs. Therefore, it is essential to have programs that are so well constructed that every student makes every response correctly.

Crowder, however, disagrees on this point. He believes that mistakes are part of learning and has developed the intrinsic or branching-type program to accommodate this. In order to see how these theories are utilized in each type of program, let us look at them in greater detail.

Linear Programing

In Skinner's linear-type program the frame contains one or more blanks to be filled in by the student in sentence-completion fashion. The blank to be filled in calls for a response that the student is equipped to make either because he learned how to make it in previous frames, or because it is made possible by the present frame with which he is confronted. Theoretically, the student learns by reading the frame, but there is no guarantee that he will learn and retain the information in the frame simply because he reads it. The type of reading required by a frame insures active and continuous manipulation of the concepts discussed in the frame. After making a response, the student compares it with the correct answer. If his answer is right, he is reinforced; if it is wrong, he is corrected. The reinforcement rewards the student's behavior, gives the learner confidence, and encourages retention. This reward or encouragement that comes from being correct has been well illustrated by Epstein and Epstein: "Everyone likes to know that he is right, or that he has

[6] Quoted in *Programmed Learning in Perspective*, Thomas, C. A. (ed.). Chicago: Educational Methods, Inc., 1963, p. 12.

done something well. Hearing the words, 'You are right!' or 'You did well!' is like receiving a prize or a reward. Usually this kind of reward makes people want to go on and do even better. The program encourages a student each step of the way. Everytime a student sees that he has given a correct answer, it is like hearing someone say, 'You are right!'"[7]

The programed learning situation includes more than one kind of reinforcement. Upon close examination, at least two kinds of student behavior are being consistently reinforced. The first is the student's response made from the stimulus and reinforced by the correct answer; the second is the behavior referred to as "paying attention." This is reinforced each time a correct response is made, with the result that the student tends to continue to pay attention and work carefully at each frame. He learns the content of the program; however, he is also reinforced for using the program, which results in continual interest and motivation to use the program.

Much research has been done by experimental psychologists on the reinforcement theory. Lysaught and Williams have formulated conclusions in regard to this theory. However, their conclusions are based on laboratory studies involving animals rather than students. Therefore, these generalizations, although some have been demonstrated with students, should be considered hypotheses rather than absolute laws. They are as follows:

> An individual learns or changes the way he acts by observing the consequences of his actions.
>
> Consequences that strengthen the likelihood of repetition of an act, one calls reinforcement.
>
> The more quickly reinforcement follows the desired performance, the more likely the behavior will be repeated.
>
> The more often reinforcement occurs, the more likely the student will repeat the act.
>
> Absence or even delay of reinforcement following an action weakens the probability that the act will be repeated.
>
> Intermittent reinforcement of an act increases the length of time a student will persist at a task without further reinforcement.
>
> The learning behavior of a student can be developed or shaped gradually by differential reinforcement—that is, by reinforcing those behaviors which should be repeated and by withholding reinforcement following undesired acts.
>
> In addition to making repetition of an act more probable, reinforcement increases a student's activity, quickens his pace, and heightens his interest in learning. These may be called the motivational effects of reinforcement.

[7] Epstein, Sam, and Epstein, Beryl. *What Is a Teaching Machine?* New York: Teaching Materials Corporation, a Division of Grolier, Inc., 1961, pp. 4-5.

A student's behavior can be developed into a complex pattern by shaping the simple elements of the pattern and combining them into a chainlike sequence.

In addition to these nine conclusions, Lysaught and Williams assume that reinforcement should inspire the student to be aware at all times that he is learning. It should persuade him to know what he is learning and should help him to regard his learning experience as enjoyable and, hence, should motivate him to partake further in learning activity.

In summarizing the principles of linear programing, we can see that there are three basic characteristics which make up this style:

a. *Active responding.* The student is actually engaged in learning by constantly responding to various stimuli within the program. This response is usually selected from a group of choices or is in written form.

b. *Minimal errors.* Although perfect performance may be impossible to attain, it is the desire of the programmer to construct his program so that there will be few opportunities for wrong answers.

c. *Knowledge of results.* The status of the correct answer as a reinforcer plays a most important role in linear programing. If the answer is not correct, the student is informed immediately and a correction is made.[8]

Branch Programing

While more and more psychologists and teachers are testing and expanding the principles of Skinner's teaching method, Norman Crowder is laboring almost alone to develop a different form of program. His approach resembles conventional teaching methods much more than Skinner's. Instead of conditioning students to learn, he provides them with a program designed to require more cognitive activity on the part of the learner.

One advantage of Crowder's intrinsic programing, as explained by Klaus, is that it is ". . . designed to meet training problems involving complex problem solving, preferably when the subject matter has a coherent, logical basis or structure which systematically can be developed step by step . . ." He further states that it is ". . . particularly useful when dealing with ranges of individual differences among learners, whenever material, automatically adapted to each learner's needs, is required." [9]

The branching style of programing is based on the theory that no two people have the same degree of intelligence. This is further explained by Crowder when he states: "It is not necessary to send bright students willy-nilly through each step of a program designed to educate the dullest

[8] Markle, Susan Meyer. *Good Frames and Bad: A Grammar of Frame Writing.* New York: John Wiley and Sons, Inc., 1964, p. 21.

[9] Glaser, Robert (ed.). *Teaching Machines and Programmed Learning, II Data and Directions.* Washington, D.C.: National Education Assoc., 1965, p. 150.

mind."[10] Therefore, the branching type of program will usually present the learner with a longer unit of material which is evidently followed by a multiple-choice type item. The branching comes into effect when the learner makes his response. Based on this response, he will be directed to his next step. If the response is incorrect, the learner is referred back to a rephrasing of the concept to be learned. In other words, Crowder capitalizes on each mistake by providing corrective feedback, explaining in more detail the concept to be learned. In addition to this, he is given information about why the specific answer is not correct. As a result, Crowder makes intelligent use of such errors and utilizes them as an integral part of the instruction. If the response is correct, he will then be directed to progress to the next frame, or in some cases, to jump ahead several frames to a new concept. Hence, Crowder's principles of programing are stimulus-centered with an emphasis on the individual differences of students. He also capitalizes on wrong answers and utilizes them to arrive at the desired learning behavior. This method is excellent for complex problem solving situations.

A Comparison

In summarizing the two designs of programing, two different philosophies have been presented. Both, however, have been built upon basic principles of learning which emphasize the importance and uniqueness of each student's own learning pattern. According to Smith and Moore, in their book *Programmed Learning*, these basic principles are:

a. Learning takes place most rapidly if the student is actively engaged with the subject matter.

b. Learning is most effective if the student develops the skills and knowledge in a form which will readily generalize to the "real life" situation for which they are intended.

c. Learning takes place most rapidly if the subject matter is organized in a hierarchic form.

d. Learning takes place most rapidly if immediate knowledge of results are given.

e. Receiving frequent "knowledge of results" keeps students working at the assigned task.

f. Since learning takes place in individuals, the learning situation should be designed so that each student may proceed at his own pace.[11]

Briefly, the difference between the two techniques is as follows. If an incorrect response is given, this should be capitalized on with corrective feedback. Skinner, however, feels that "multiple-choice questions are the greatest evil in American education," and he further explains that "effective multiple-choice material must contain plausible wrong answers, which are out of place in the delicate process of shaping behavior. . . . Every wrong answer on a multiple-choice test increases the probability that a student will some day dredge out of his imperfect memory the

[10] Fine. *Op. cit.*, p. 70.

[11] Smith, Wendell I., and Moore, William J. *Programmed Learning*. New York: D. Van Nostrand Co., Inc., 1962, p. 84.

wrong answer instead of the right one." In other words, Skinner believes that errors should be prevented because the ultimate objective is a correct response. One of his cardinal rules is that "learning should be as nearly errorless as possible. Wrong answers are like static; they interfere with the clear reception of ideas." [12]

With this brief overview of programed instruction, we move now to a thorough and unique discussion of the designs of programing.

[12] Quoted in Fine, *op. cit.*, p. 57, 68.

2

Theory and Designs of Programs

MARY OST AND ROBERT CLAYTON

This chapter differs from others in this book. Some of it is programed—a logical approach to the presentation of the theory behind programing—and it includes specific examples of the two common forms of programing that are in use today. In addition, the chapter includes a listing of specific objectives which the reader is expected to meet when he is finished. Finally, to prove that programing can be an effective teaching method, a self-examination is included at the end of the chapter.

Usually students pass over any listing of objectives because such listings are vague. However, the objectives listed here are written quite differently. The rationale behind this difference will be discussed shortly.

After learning the material presented in this chapter, the reader will be able to score 90 percent or better on the test found at the end of the chapter. The test items will include the following:

Define, in a written statement, the term "behavioral objectives."

Identify, from a list of behavioral objectives, those which meet the criteria established by Robert F. Mager.[1]

Select, from a series of matching questions, those statements which describe the mechanical aspects of linear and branching techniques.

Identify and correct all the wrong true-false type of statements which describe the educational theory, the desirable characteristics, and the shortcomings inherent in the linear and branching techniques.

Behavioral Objectives

Most people who have studied the different types of programing all agree on one thing—at the outset of programing there must be a precise listing of exactly what it is that the student will learn. The material to be learned is defined as a series of *objectives*. It is now customary to list these objectives in the behavioral form and to call them *student objectives*. Behavioral objectives describe the sort of behavior which is exhibited by

[1] Mager, Robert F. *Preparing Objectives for Programed Instruction.* San Francisco, Calif.: Fearson Publishers, Inc., 1962.

the student to show that he has learned, and which can be precisely observed or evaluated by the teachers. There should be no doubt on the part of either the student or the teacher as to how the student is tested or what standard he is expected to attain.

Mager has indicated that the three essential features of a well-written behavioral objective are:

a. to identify (e.g., to state, to list, to serve a ball, to compare, etc., what the learner will be doing when demonstrating he has achieved the objective).

b. to describe the important conditions under which it will occur (e.g., when given a multiple-choice test, when using a regulation racket and ball, when demonstrated by an expert, etc.).

c. to specify the criteria of acceptable performance (e.g., prevent a score by legal means, to sink 9 out of 10 throws, to score 85 percent of the total possible points, etc.).

To illustrate further, consider the objectives below. Refer to the above material if desired, but indicate if each one meets Mager's requirements.

a. The student will understand the strategy of playing badminton.

b. The student will be able to serve and receive a tennis ball correctly.

c. The student will be able to correctly explain the relationship of smoking and emphysema, as described by the Surgeon-General's Report.

d. The student will be able to correctly apply indirect pressure to the brachial artery of a fellow student in order to shut off blood flow to the lower arm.

The last two objectives are much better than the first two. Notice that they are also longer. This length cannot be helped, as the more precisely one writes, the more words it takes. Look at the first two objectives again. What exactly does "understand" mean? Exactly what strategy will be understood? How does one demonstrate that he understands? What is a "correct" tennis serve? Does receiving the ball mean just being able to hit it, or must the student it it back over the net? If it must be hit over the net, must it land inside the court? These and many more questions can be asked about the first two objectives.

On the other hand, the last two objectives do meet the requirements stated by Mager. The desired behavior (identify, explain, apply) is named, the conditions(described in the Surgeon-General's report, applied to a fellow student) are described, and the criteria (as described by the Surgeon-General's report, shut off blood to lower arm) are identified.

Why should behavioral objectives be formulated? Teachers must think about the objectives they have written for their teaching units. Do the students actually know beforehand what is expected of them at the end of the unit? Would they be more apt to meet the standards if they knew precisely what those standards were? Would another teacher know exactly what was going to be taught? It is virtually impossible for a person to correctly evaluate his teaching unless precise behavioral objectives are used, and it is impossible for a program to be evaluated without them.

LINEAR PROGRAMING

To explain this type of programing, the following 12 pages of this chapter are presented exactly as they might appear in a linear programed test. Each section, or frame, is contained within a pair of double lines and consists of three parts as illustrated.

1. Statement	
2. Answer	3. Question

Below is an outline of the mask needed to take the programed test in this chapter. It is the exact width of the boxed material on the following pages. From heavy paper or cardboard, cut a mask the same size as the model below.

To complete each frame, first align the top edge of the mask with the double horizontal lines at the top; then follow these three distinct movements:

a. To read the statement, slide the mask *down* until its *top* edge reveals the single horizontal line just below the statement.

b. To read the question, slide the mask *up* until the same single line is revealed by the *bottom* of the mask.

c. To expose the answer, slide the mask *down* again until its top edge reveals the bottom double line.

Proceed with subsequent frames in the same manner until the program has been completed.

1. The basic unit of organization for the linear program is called a frame.	
frames	The individual units of a linear program are called f________.
2. There are several ways of constructing frames. In this program each *frame* has three parts: a short *statement*, a *question* based on that statement, and finally the *answer* to the question.	
a. Statement b. Question c. Answer NOTE: Your answers may be in any order but actually the statement precedes the question.	The three parts of a frame are: a. ________ b. ________ c. ________
3. In this program the answer to the question is given in the *left* margin of the frame. In some programs the answer appears on the next page. The important point to remember, however, is that the answer is given before the next statement is read.	
before	The answer to a question appears (before/after) the next statement.
4. Sometimes the question and statement are combined in the same section of the frame.	
a. Statement b. Question c. Answer	In this program, the frame sections are read in this order: a. ________ b. ________ c. ________
False	True or false—all linear programs are written in this same fashion.
5. A definition of linear programing would be: a technique whereby the learner is given a small segment of information, asked a *question* concerning that information, and then *checks his answer* with the correct one *before going on* to the next frame.	
information answer a question proceeds or continues	In linear programing, the learner is first given a small piece of ____________; second, he must ________ about the information; and third, he compares his answer with the correct one before he ____________.

6. Linear programing is more than just reorganizing a regular written paragraph. Basically, it calls for small pieces of information to be arranged in a certain sequence.

information sequence	Linear programing presents small segments of .... arranged in a specific ....

7. The sequence in which this information is presented is important.

the order in which the facts are presented, or words to this effect	In linear programing, the "sequence" refers to ....

8. Linear programing is effective partially because the sequence of frames is carefully worked out and tested on many learners before being finally set.

programers and learners	The sequence of frames is determined by two groups of people. These are: .... and ....

9. In general, a programed sequence begins with a simple or already known fact, and proceeds to more complex or unknown information.

unknown simple	Programing follows the pattern of moving from the known to the .... (This can also be termed from the .... to the complex.)

10. The name "linear" comes about because the facts are presented one after the other, with no side tracks or branches.

sequence known	A linear program is identified by a carefully tested s.................... of facts, moving from the .... to the unknown, with no variation or side tracking.

11. When one fact after another is presented we use the term "linear."

linear	When the facts to be learned are presented one after the other, we use the term .... to describe the program.

12. Although linear programers use different techniques, they generally present no more than one piece of information in each frame.

linear frame	In .... programing, only one fact is presented per ....

13. Because only one bit of knowledge is given in each frame, learners should be able to answer the question correctly.

piece of information, bit of knowledge, fact, or similar statement. increases NOTE: You have undoubtedly wondered why the answers to these questions seem so simple. This is a good illustration of the "one fact, one question" idea.	Because only one ______________ ______________ is presented to the learner at a time, this greatly (increases/decreases) the chances that the learner will answer correctly.

14. The theory underlying linear programing relates to the idea of the student making very few mistakes in his answers.

c. Very few mistakes. NOTE: If no mistakes were made, it would be even better, but this goal never seems to be reached.	A linear program should be designed so the learner can work through it and make *how* many mistakes? (Choose correct answer.) a. A great many mistakes. b. A moderate amount of mistakes. c. Very few mistakes. d. Absolutely no mistakes.

15. Terms used to discuss linear programing are:
a. Learning b. Conditioning c. Reinforcement d. Reward
Read these four terms again. Repeat them a few times.

a. Learning b. Conditioning c. Reinforcement d. Reward	You will soon be studying four terms which are used to discuss linear programing. These are: a. L______________ b. C______________ c. R______________ d. R______________

16. Learning is universally defined as a *consistent change* in *behavior* when exposed to the *same stimulus.*

behavior stimulus	Learning involves a consistent change in ______________ which takes place when a learner is repeatedly presented with the same ______________.

17. When one consistently behaves in a certain manner after receiving the same stimulus, he is said to have "learned."

Consistent behavior when exposed to the same stimulus. (Or words to this effect.)	Define "learning" in your own words. Be sure to include the terms "stimulus" and "behavior" in your definition.

18. Consistent behavior depends upon *conditioning*. We become conditioned to give the same reaction to a certain stimulus if we repeat the reaction several times.

conditioning	We have said that learning involves a consistent change of behavior. This behavior becomes consistent through the process of ______

19. Repeating the reaction (or practicing) results in conditioned responses. The more pleasurable the response, the more one wants to practice.

pleasurable We want to repeat pleasurable responses more than unpleasurable ones.	In theory, a response is apt to be conditioned sooner if it is (unpleasurable/pleasurable.) Why?

20. What makes a response pleasurable? In most cases, it is a successful performance. For example, a person is more likely to want to practice a swimming stroke after he has had some success in doing it. Until at least some success is experienced, one is usually not very eager to practice.

Pleasurable responses are those which are successful. We tend to practice these types of responses so often that they become conditioned ones. (Or words to this effect.)	"Pleasurable" and "success" are related terms. Construct one or two sentences which indicate how the terms "pleasurable" and "successful" tend to result in conditional responses.

21. When a person emits a response successfully, he has a feeling of happiness. He is *rewarded* by this feeling.

feeling	When used in connection with a theory of learning, a reward is the ______ that a person has after making a successful response.

22. "Reinforcement" is a term which stands for anything which makes a response more likely to be repeated.

reinforcement	In order to get a student to repeat a response, the teacher should use some type of ______.

23. The more a successful response is practiced, the more that response is reinforced.

reinforced	A repeatedly practiced response is repeatedly ______

24. When the same stimulus consistently brings the same response, a *conditioned response* has been developed.

conditioned response	A ______ means that a certain stimulus always brings a certain response.

25. In a conditioned response there has been a change in behavior so that a person gives a certain response when exposed to the same stimulus.

learning	Conditioned responses indicate that ______ has taken place.

26. Let's summarize a bit:
   a. Learning is a consistent change in behavior as a result of exposure to the same stimulus.
   b. We are rewarded when certain responses are pleasurable.
   c. Pleasurable responses tend to be repeated more often than unpleasurable ones.
   d. A reinforced response is pleasurable and tends to be repeated.
   e. A conditioned response occurs when the same stimulus brings the same response.
   f. Conditioned responses indicate that learning has taken place.

	Review:
a. linear	a. A program which presents the facts in an unvarying order is called a ______ program.
b. frame	b. The basic unit in a linear program is the ______.
c. unknown	c. The sequence of information presented in a program are carefully arranged so that the learner moves from the known to the ______.
d. one	d. A linear program presents ______ fact(s) per frame. (how many)
e. behavior stimulus	e. Learning is a consistent change in ______ when exposed to the same ______.
f. all of these	f. Which of the following responses tend to be repeated? 1. pleasurable 2. rewarded 3. reinforced 4. all of the above

27. The key to the success of linear programing is the application of the principle of "one fact and one question per frame."

frame	"One fact and one question" describes the material found in one .... of a linear program.

28. In linear programing, the reward comes when the student checks his answer with the correct one and finds that they are the same.

reward	When a student sees that his answer matches the correct one, he receives a ....

29. The learner is rewarded because he knows that he answered the question correctly.

reward	It is pleasurable for the learner to give a successful (or correct) answer. This is an example of a ....

30. When a question is asked concerning material that has just been presented, there is very little chance of an error.

error	The short period of time between the reading of the statement and the asking of a question minimizes the chance of ....

31. Linear programers try to write so that at least 90 percent of all the students will answer each question correctly.

Ninety	One of the guidelines for writing a program is that .... percent of the learners should respond correctly to any one question.

32. All frames in linear programs do not present new information. Many contain repetitive statements.

repeated	Presenting a new fact once does not insure that it will be learned. Instead, many facts must be .... in a program.

33. Repetition is called for in linear programing because the correct response must be practiced several times.

practiced or re- peated behavior	The correct response must be .... several times in order to cause a consistent change in ....

34. For an example of repetition, look back to Frames 16 and 17. Note that they say the same thing.

the same	Frames 16 and 17 say .... thing(s).

35. Repeating statements and asking similar questions will force the learner to practice the correct response several times.

repeatedly answer correctly those questions dealing with a new fact or concept (or words to this effect).	The programer knows when learning takes place because the student is able to ______________ ______________.

36. When the program writer is convinced (by testing) that most learners know the new information, he goes on to the next fact.

Ninety	A programer continues to test and revise his program until ______________ percent of the learners respond correctly to each frame.

37. There is research to show that this conditioning theory is effective. Evidence shows that even a linear program which violates many of the "scientific" principles is better than no program at all.

	A good program:
a. one	a. presents ______________ fact(s) per frame.
b. unknown	b. moves from the known to the ______________.
c. repeats	c. R______________s material several times.
	But even if it does not use these techniques, a program may still teach.

38. Thus, one desirable feature of linear programing is that it works. Whether long, short, good, or bad, a linear program can result in a change of behavior.

learning	Even a poorly written linear program can result in ______________ (or change in behavior).

NOTE: Many of the terms defined in this chapter were first presented in Chapter 1 and should have been learned there. However, if you didn't learn them until this chapter, you have reinforced our point that programing can be more effective than regular presentations.

39. Another desirable feature, at least in the minds of many learners, is that a linear program seems to be well organized.

organize	The nature of the linear program forces the programer to ______________ his thoughts into a step-by-step sequence.

40. The sequence of a linear program forces the learner to go from one fact to another, with no wandering.

sequence or order	In a linear program all learners follow the same ______________ of frames.

41. One feature of linear programs is highly personal. Some writers naturally write best when following a small-step, highly structured format. Some learners like this approach, other writers and/or learners dislike it intensely.

	There can be no question here; you either like this style or you don't. The important fact to remember is that linear programs are effective, regardless of what you prefer.

42. The questions required in this type of program are of a certain type. For many writers, a desirable feature of linear programs is the ease of writing questions that are *short, direct*, and usually have *precise* answers.

short direct have precise answers	Certain writers favor the type of questions asked in linear programs. These may be described as ...., ..., and ....

43. Linear programs have definite shortcomings. One is that they can be very boring.

wrong answers boring	Linear programs are written so that there will be very few .... to the questions. This usually means one statement—one question per frame. This can lead to a very .... program.

44. Linear programs, because they are written to minimize student errors, tend to be repetitious.

errors repeated or presented NOTE: This is a good example of a boring repetitious frame.	In order to keep the number of .... small, each concept in the program must be .... several times.

45. To many learners, repetition is boring. Even though they realize that one correct answer might not mean that they have learned, they still balk at answering another question on the same fact.

	Go on to the next frame. We wouldn't want to bore you with another "repetitious" question.

46. A major shortcoming of most linear programs is that all learners, regardless of their reading rate or intelligence, take about the same time to finish the program.

same amount of time.	Since all learners must work through each frame of a linear program, they will all finish in about the ....

47. It is assumed in many programs that all learners have the same background, and thus need to read and answer all frames.

background.	A linear program that forces each learner to read every frame assumes that they all have the same ....

48. It is possible for linear programs to provide for individual differences in background and intelligence, but this departs from the technique proposed by Skinner and is seldom done.

can	A linear program (can/cannot) provide for some individual differences.
do not	Most linear programs (do/do not) provide for much difference between students.

49. A very important shortcoming of linear programing is that it costs more than other techniques.

more	Compare with other programing techniques, the linear method costs (more/less) to produce.

50. Glance back at the number of frames you have read so far. Actually, you have not been given a large amount of information, but note how much space it has taken.

space	The major reason why linear programing costs more is because it takes a great deal of .... to present a small amount of information.

51. In other words, in a linear program there is a great amount of blank space on the paper. This is space where the student writes his answer or does something else to signify that he has learned.

answer the question which appears in each frame.	Much blank space is needed for the student to ....

52. A linear text for students in a large class requires considerably more paper than other types. If a teaching machine is used, the cost of the paper is considerably less, but the cost of the machine must be considered.

linear	Whether using a teaching machine or text format, the .... technique still costs more than other programing techniques.

53. To sum up the shortcomings of linear programing, one may say that it can be boring, oblivious to individual differences, and costly.

	The shortcomings of linear programing are:
a. repetition	a. often borning because of ....
b. individual differences	b. does little to provide for ....
c. costly	c. is quite .... to produce.

54. The shortcomings may not convince you that linear programing is worthwhile. Why is it recommended so highly by teachers who have used it?	
a. works or is effective b. organized	The three shortcoming we have mentioned might be weighed against two desirable features: a. linear programing ______. b. learners like it because of the highly______ structure.
55. When compared to conventional teaching methods, the major advantage of programing (whether linear or branching) is that it virtually guarantees that the person can learn *on his own*.	
learning or a change in behavior a teacher	Not only can programs cause ______ ______ but they can do it without requiring the constant presence of ______.
56. Most teachers do not have enough time to work with those people who need special help or to teach all the material that students should know.	
Programed instruction	______ can be used to teach the constant, unchanging parts of a subject matter and frees the teacher to give individual help to those who need it.
57. Programing frees the teacher from spending class time in discussion or study of certain materials. If concepts or facts have been programed, students will learn on their own.	
own	Every subject matter has a body of facts or concepts which students can learn on their ______ if given the right circumstances.
58. For most teachers who use programed materials, the gain in teaching time more than offsets the disadvantages of linear (or branching) programs.	
time	The greatest advantage of using programed materials is that it gives the teacher more ______ to work with individuals.
59. The desirable features of linear programing are its: a. effectiveness in causing learning to take place. b. well-organized format. c. ability to enable the student to learn without the teacher needing to be present.	
a. change b. organized c. time	Linear programing is said to: a. be effective in causing a ______ in behavior. b. be well ______. c. give the teacher more teaching ______.

60. Let's see what you remember from the last part of this section.

	True or False—the following are characteristics of good linear programing.
a. False	a. Four frames would probably contain four facts.
b. False	b. Programers try to write so that no more than 75 percent of the students will answer every frame correctly.
c. True	c. Programers try to write so that 90 percent of the answers will be correct.
d. True	d. A programer discovers how often a fact must be repeated by testing his program.
e. False	e. Each new fact in a program must be repeated at least four times.
a. boring b. oblivious to individual differences c. costly	List 2 of the 3 *disadvantages* of programed instruction mentioned previously.
a. Its effectiveness to cause learning to take place b. Its well-organized format c. Its ability to enable the student to learn without the presence of a teacher	List 2 of the 3 *advantages* mentioned previously.

BRANCHING PROGRAMS

We have chosen to explain the branching technique in the most appropriate format—which is a branching program, a technique somewhat different from the linear type. Begin by reading Paragraph 1. Next read the question which follows, select what you consider to be the correct answer, and turn to the paragraph indicated by that answer. Repeat this procedure until you finish the explanation of branching programs.

Paragraph 1

A branching program is one in which the student is asked to read a paragraph of several sentences. This paragraph may contain a series of facts, a detailed explanation of a concept, or a general discussion which is pertinent to the topic. Following this information, a question is asked. The student is shown two or more answers and is asked to select the correct one. Each answer directs him to a different location.

Question: There are five sentences in the paragraph above. On the basis of what you have learned earlier in this chapter, which type of program—linear or branching—will take the *least* amount of *space* to present its information in this book?

a. Linear. (If you select this as the correct answer, go to paragraph 3)

b. Branching. (If you select this as the correct answer, go to paragraph 2)

Paragraph 2

You said that a branching type of program would take less space to present its information in this book than a linear type. On the basis of what you know so far, you are correct. You undoubtedly concluded that since the branching type contains more information per paragraph than the linear frame, it must take less space. Please go to paragraph 4.

Paragraph 3

You thought that a linear program would take less space to present its information in this book. On the basis of the information presented in paragraph 1, you are wrong. This information would probably have taken five frames in a linear program, and would cover at least one page.

Turn back to paragraph 1, read the question again, and then select the correct answer.

Paragraph 4

Some of you have now read paragraphs 1 and 2, whereas others have read 1, 2, and 3. Paragraph 3 was read only by those who did not answer the question in paragraph 1 correctly. We use the term "branch" to describe paragraph 3 because it is an explanation of information already presented and need not be read by everyone. Those answering every question correctly will remain on the main learning road and not visit any of the "branches" of this program.

The mechanics of a branching program imply that:

a. Everyone reads every paragraph. (Go to paragraph 5)

b. Everyone reads certain paragraphs, but not necessarily all of them. (Go to paragraph 6)

Paragraph 5

Wrong. The branching technique means that only those who need to read every paragraph—because they make wrong choices of answers—do so. Those who make correct choices have no need to read those branching paragraphs which restate material already given.

Turn back to paragraph 4. Read the question again, and select the other answer.

Paragraph 6

Right. There is no need to read every paragraph if some are merely branches which repeat already-given material.

One way to define the branching method would be to say that it is a technique whereby the learner: (1) studies a logical segment composed of several bits of information, (2) attempts to correctly answer a question based on the information given, and (3) is directed to remedial branches if his answer is incorrect. When he selects the correct answer, he progresses to the next segment of information.

Which one of these is a *complete* and *correct* definition of the branching technique? (Please do not look above for the correct answer. If you don't know, the answers below will lead you to remedial work.)

a. It includes *one or two facts* to study, an *examination, remedial work* if necessary, and *progression* to the next segment of information when the correct answer is given. (Go to paragraph 10)

b. It includes *much material* to study, an *examination,* and the *correct answer.* (Go to paragraph 8)

c. It includes *several bits of information* and *progression* to the next segment of information when the correct answer is selected. (Go to paragraph 7)

d. It includes *several bits of information,* an *examination, remedial work* if necessary, and *progression* to the next segment of information when the correct answer is selected. (Go to paragraph 9)

Paragraph 7

You said that the best definition of the branching technique was that "it includes *several bits* of information and *progression* to the next segment of information when the correct answer is selected." This is not quite right; there are additional characteristics which should be mentioned. Go back to paragraph 6 and select another answer.

Paragraph 8

You said that the best definition of the branching technique was that "it includes *much material* to study, an *examination,* and *the correct answer.*" It does include all these, but this could also describe the linear technique. Go back to paragraph 6 and select a better answer.

Paragraph 9

You said that the best definition of the branching technique was that "it includes *several bits* of information, an *examination,* remedial work if necessary, and *progression* to the next segment of information when the correct answer is selected." You are absolutely right. Please turn to paragraph 11 for the next "logical segment composed of several bits of information."

Paragraph 10

You said that the best definition of the branching technique was that "it includes *one or two facts* to study, an *examination, remedial work,* if necessary, and *progression* to the next segment of information when the correct answer is given." This is not quite correct. Remember an earlier question about the space requirements of each type of program? A linear program presents *one* bit of information per frame but the branching program presents *several* bits of information in the segment to be studied. Go back to paragraph 6 and select another answer.

Paragraph 11

The sudden use of the term "remedial" may be confusing. If a person selects the wrong answer, it is obvious that remedial action is needed. This is why branches of the program are used when an incorrect answer is given. Each wrong answer directs the learner to a separate branch where specific remedial information can be given.

"Remedial work" is a term that describes which one of the following steps of the branching technique?

a. Logically arranged segments of information. (Go to paragraph 15)
b. Examination after studying. (Go to paragraph 14)
c. Branches of the program. (Go to paragraph 13)
d. Progression to next segment of information. (Go to paragraph 12)

Paragraph 12

The term "remedial work" does not describe "progression." It would be illogical to progress to the next segment of information while the need for remedial action still exists. Return to paragraph 11 and select a better answer.

Paragraph 13

Right. Remedial work does describe the reason for the branches of the program and, thus, it is the best answer given.

Why does the branching technique work? Socrates and other master teachers used oral questions as diagnostic devices. Similarly, in the branching technique the answer to one question determines which branch of the program will be taken next. It may be that the student is allowed to go to the next segment of information, or it may be that he is given remedial work until he is able to select the correct answer. Diagnosis of past learning—as shown by answers to the examination—determines what branch the student reads next.

Branching is an effective technique of teaching because it is closely related to the type of learning which is found during:

a. Lecturing. (Go to paragraph 16)
b. Tutoring. (Go to paragraph 18)
c. Reading. (Go to paragraph 17)

Paragraph 14

"Remedial work" is not as closely related to "examination" as it is to another answer given. True, the examination will indicate if remedial action is necessary, but the exam must come first. Please return to paragraph 11 and select another answer.

Paragraph 15

Wrong. While it is true that segments of information which are *not* logically arranged will result in the need for remedial action, this still is *not* a very good answer. Besides, the need for remedial work cannot be determined until after the examination. Return to paragraph 11 and try again.

Paragraph 16

Lecturing is not a particularly effective way of teaching because the teacher cannot know what the student is actually learning during the lecture. The student may not have understood a key concept early in the session and thus is unable to grasp the remainder of the material. He may have been asleep, or perhaps he could not hear the words spoken by the lecturer. An exam after the lecture will show what has been learned but this exam is not part of the lecture. Please go back to paragraph 13 and select another answer.

Paragraph 17

Wrong. Reading can be an effective way of learning but unless some sort of examination is given after each segment of information the student has no way of knowing whether or not he has truly learned. Return to paragraph 13 and select a better answer.

Paragraph 18

Right. The branching technique is an effort to use the tutorial system on paper. Tutors continually ask questions, with each following question based on the answer to the previous one.

The term *intrinsic* means "within" and is often used to describe branching programs. An intrinsic program is one in which each answer to a diagnostic question determines the exact route taken by the learner. In other words, the programer does not determine the next paragraph that will be read by the student; the program contains within itself several alternate branches.

Which is the *best* description of an intrinsic program?

a. Based on the knowledge within himself, the student determines what paragraph he will read next. (Go to paragraph 25)

b. The correct answer to each question is found somewhere within the paragraph. (Go to paragraph 19)

c. Each paragraph provides an opportunity for the learner to measure the knowledge within himself before he goes on to the new segment of information. (Go to paragraph 22)

Paragraph 19

You say that an intrinsic program is best described by the statement "The correct answer to each question is found somewhere within the paragraph." This statement is generally true but is not the best answer to the question. The main distinction of an intrinsic program is that it lets the learner *use* the knowledge within himself to determine his next step. This answer says nothing about this inner direction and merely indicates that the correct answer is present. Also, this statement could describe a linear program. Return to paragraph 18 and select a better answer.

Paragraph 20

Wrong. The usual linear program cannot be called "intrinsic." Intrinsic refers to the fact that the learner decides, through his answer to a question, what branch of the program he will take. "Extrinsic" refers to the fact that an outside person determines in what order the material will be studied. Go back to paragraph 25 and select another answer.

Paragraph 21

Right. The usual linear program is extrinsic because progression is determined by the writer, not the learner.

When compared to linear programs, branching appears to have several advantages. We have already indicated that individual differences are considered by the writer of branching programs because he provides remedial work when needed. The point to be remembered is that a good branching program attempts to meet individual differences by asking and then answering all the questions—both true and false—that students would normally ask.

When compared to the usual linear programs, individual differences appear to be best met by branching programs because:

a. One paragraph contains much more information and explanation than one frame. (Go to paragraph 24)

b. Learners are given a wide selection of possible answers followed by remedial branches if necessary. (Go to paragraph 27)

Paragraph 22

You said that an intrinsic program is best described by the statement "Each paragraph provides an opportunity for the learner to measure the knowledge within himself before he goes on to the next segment of information." Perhaps you are right, but it depends on your thinking. You are wrong if you assume that all learners read the information, take a test, and then go to the new material. However, if your view is that the test results determine whether the learner goes to either new or remedial material, then fine. Go on to paragraph 25, please.

Paragraph 23

Mostly wrong. We are glad that you knew that a linear program is also called an extrinsic one, but we are chagrined because the rest of the statement enticed you. Whether or not the impetus for learning comes from within or without the learner has not been discussed. Return to paragraph 25 and select the right answer.

Paragraph 24

Your answer was that branching appears to meet individual differences better than the linear technique because one paragraph contains more information and explanations than does one frame. The amount of information *is* greater in branching programs, but this is not the desired answer. The extra amount of explanation in the paragraph would be fine for those who needed it but would be wasteful of time for those who didn't. The needs of the better students would best be met by shorter explanations, not longer ones. Return to paragraph 21 and select the other answer.

Paragraph 25

You said that an intrinsic program is one in which the student, after measuring his own knowledge, determines what paragraph he will read next. Right.

Extrinsic is the opposite of "*intrinsic*" and is often used to describe linear programs. Most extrinsic (or linear) programs are designed under the assumption that all learners need to read every frame. Thus, the material to be studied is determined extrinsically (by the writer) as opposed to intrinsically (by the learner).

Which statement would best describe the usual *linear* program?

a. It is intrinsic in that the information, question, and answer are all given within one frame. (Go to paragraph 20)

b. It is extrinsic in that the progression through the material is determined in advance by the writer. (Go to paragraph 21)

c. It is intrinsic in that the material to be studied is dependent upon the knowledge of the learner. (Go to paragraph 26)

d. It is extrinsic in that the impetus for learning comes from outside the learner. (Go to paragraph 23)

Paragraph 26

Wrong on two accounts. First, the terms "linear" and extrinsic" are related, while the terms "linear" and "intrinsic" are not. Secondly, the last part of the statement—"material to be studied is dependent upon the knowledge of the learner"—is wrong because it describes an intrinsic program. An extrinsic program is characterized by an outside influence on the material to be studied. The programer is the outside influence. Go back to paragraph 25 and select a better answer.

Paragraph 27

Right. It stands to reason that a wide selection of remedial branches, based on the need as shown by the test results, would help meet individual differences. The usual linear programs do not have these branches.

An obvious advantage of the branching program over the usual linear type relates to the time needed by the learners to finish the program. Because they read only those branches which are needed (opposed to every frame), the time spent on the program can be shortened for certain learners. Those who need such remedial work will get it, but many will be able to proceed faster.

Branching programs have an advantage over the usual linear programs because they possibly can save time for which of the following people?

a. The writer, because more information is presented in one segment. (Go to paragraph 29)

b. The student, because he is not forced to read every paragraph. (Go to paragraph 31)

Paragraph 28

You thought that the advantage of branching programs over linear was that it made better provision for individual differences. You are right, but there are more advantages than this. Please go back to paragraph 31, read all the answers again, and select a more inclusive one.

Paragraph 29

You thought that one advantage of branching programs was that they would save the time of the writer. Not necessarily. It has taken virtually the same amount of time (60 hours) to program each of the two sections of this chapter. Remember that branches must be written for each paragraph. Return to paragraph 27 and select the other answer.

Paragraph 30

You thought that the advantage of branching programs over linear was that it was a time saver for certain students. You are right, but there are more advantages than this one. Please go back to paragraph 31, read all the answers again, and select a more inclusive one.

Paragraph 31

Yes, certain students can finish a branching program in less time than it usually takes for a linear one.

Whether there is a saving of paper and space with a branching program varies with the program. Note the pages devoted to each of these types in this chapter. If every possible remedial branch were provided, the linear and the branching would probably require the same number of pages. However, the usual program provides only two to four branches for each segment of information. Viewed from this approach, branching does take less paper and space.

The advantage (or disadvantage) of branching over linear programs is best summarized by which *one* of these answers?

a. Better provision for individual differences. (Go to paragraph 28)
b. Time saver for certain learners. (Go to paragraph 30)
c. Possible saving of paper and space. (Go to paragraph 33)
d. Answers *a* and *b* above. (Go to paragraph 34)
e. Answers *a, b,* and *c.* (Go to paragraph 35)

Paragraph 32

You are correct in saying that the skill of the programer is the key consideration as to whether the branching or linear type of program has the better question.

Another possible disadvantage was mentioned earlier. It is virtually impossible to construct a branch for every conceivable answer that a student would select. Every individual difference, then, is not necessarily provided for. There still will remain some learners who will need but not receive remedial work.

If all individual differences were met, which advantage of a branching program over a linear program would disappear?

a. Use of less paper and space to write the program. (Go to paragraph 36)
b. Shorter time needed to complete program. (Go to paragraph 39)

Paragraph 33

You thought that the advantage of branching programs over linear was that it possibly saved time and paper. You are right, but there are more advantages than this. Please go back to paragraph 31, read all the answers again, and select a more inclusive one.

Paragraph 34

Your answer said that the advantages of branching over linear texts was that they better provided for individual differences and saved time for certain learners. You are right, but not completely so. There is one better answer than the one you selected because there were more than these two advantages given. Please go back to paragraph 31, read the answers again, and select a more inclusive one.

Paragraph 35

Right!

There are certain features of branching programs which might be called disadvantages. An important one has to do with the method of evaluating the learner. In a branching program, there are at least two answers given, sometimes more. Suppose the learner just guesses. He could have as much as a 50-50 chance of selecting the right answer. A linear program usually requires answers to be constructed, whereas the branching type provides them.

In what situation would the learner be required to *know* more and *guess* less?

a. Answering a question in the usual linear program. (Go to paragraph 38)

b. Answering a question in the usual branching program. (Go to paragraph 37)

c. Neither. It depends on the skill of the programer. (Go to paragraph 32)

Paragraph 36

Yes. If the remedial needs of every reader were to be met, the branching program would probably take even more space than the linear.

To prevent students from glancing ahead to the correct answer it is customary for branching programs to be "scrambled." In other words, the branches are not in consecutive order. This bothers some people; the scrambled text simply does not seem to be well-organized enough for them. However, it is apparent that this is merely a mechanical arrangement.

You have finished the "scrambled text" portion of this chapter. Which one of these statements best describes your feeling about the scrambling format?

a. The scrambling disturbed me. I consider it a disadvantage of the branching technique. (Go to paragraph 40)

b. I do not consider the scrambling technique to be disturbing or cumbersome. (Go to paragraph 41)

Paragraph 37

You thought that the question in a branching program would require more knowledge on the part of the learner. Perhaps—and perhaps not. Wouldn't it really depend on the question? A multiple-choice question and answer *could* be much better than the simple "fill in the blank" sometimes found in a linear program. It also could be much poorer than a learner-constructed answer. Return to paragraph 35 and select a better answer.

Paragraph 38

You thought that the question in a linear program would require more knowledge on the part of the learner. Perhaps—and perhaps not. Wouldn't it really depend on the question? A learner-constructed answer could be much better than one already made by the programer. However, it could also be much poorer. Return to paragraph 36 and select a better answer.

Paragraph 39

No. Just because the individual needs of every reader were met, the time needed to finish the program would not necessarily be longer. Unless the learner needed the remedial work, he wouldn't read all the remedial frames. Go back to paragraph 32 and select the other answer.

Paragraph 40

Please go to paragraph 41.

Paragraph 41

Actually, whatever answer you selected in paragraph 36 directed you to this spot. Your answer has to be correct because you were asked about your personal feelings. Your personal preference will determine the type of program that you use. We hope that you will remember some of the pros and cons about either type, and also the fact that research has not shown one type to be clearly superior to the other.

Self-Examination

You remember that earlier we listed four objectives that you should be able to meet after reading this chapter. You might turn back to page 11 to refresh your memory, because the material below contains questions designed to see how much you have learned. If you score 90 percent or better, you have met the standard we think you should.

Questions

1. Define the term "behavioral objective," being sure to include features which Nager considers essential. You may look at the examples in question 2 for clues.

2. Check those objectives in the following list which meet the criteria established by Nager:

a. The student will be able to tread water in 7-9 feet of water for 1 minute. (Treading is defined as maintaining the face above water while not moving outside a circle 8′ in diameter.) a. ______

b. Given a list of possible first aid procedures, the student will be able to correctly choose which procedure(s) would be used in caring for a victim of shock. b. ______

c. The student will be able to execute a correct basketball hook shot. c. ______

d. Given a 9 iron and a regulation golf ball, the student will be able to "chip" the ball 4 out of 5 times into a 7′ diameter 20 yards away. d. ______

e. The student will understand how to correctly serve a volleyball. e. ______

f. The student will know when it is appropriate to use the hit-and-run strategy in a softball game. f. ______

3. Put the letter "L" beside each of the following characteristics which are usually unique to linear programing, and the letter "B" beside those usually unique to branching programing.

a. all learners read all parts a. ______
b. several pieces of information are presented at once b. ______
c. sometimes called intrinsic c. ______
d. sometimes called extrinsic d. ______
e. students progress to new material only when they give the correct answer e. ______
f. students progress to new material even if they answer incorrectly f. ______
g. written in such a way that learners make very few errors g. ______
h. student errors are anticipated and remedial work is provided h. ______

4. Judge only the truth or falseness of the italicized word or words. If the statement is true, place a T in the space provided and go on to the next item. If the statement is false, place an F in the space and write the correction on the line following it.

a. The linear programer designs his program so that *80 percent* of the learners will answer each frame correctly. a. ______

b. When a student sees that his answer matches the correct answer he is *reinforced*. b. ______

c. From the learner's point of view, branching programs are generally *more* organized than linear ones. c. ______

d. The repetition which is part of *linear* programs is often the cause of boredom. d. ______

e. The usual *linear* programing makes more provision for individual differences than does the other type. e. ______

f. In most branching programs, those students who grasp the material quickly take *more* time to complete the program. f. ______

g. In most linear programs, those students who grasp the material quickly take *more* time to complete the program. g. ______

h. A *branching* program considers diagnosis to be more important than conditioning. h. ______

i. One of the shortcomings of a branching program is that the student is presented with a choice of possible answers and there is the possibility that *he can guess* the correct answer. e. ______

j. In most linear programs, if a student misses a question he is *directed to remedial material*. j. ______

Answers

Compare your answers carefully with those given below. Score your answers according to the criteria shown, and record your score in the proper space. When finished, add your score and compare with our previously determined standard of 90 percent (27 points).

1. Score two points for each part of this definition which you have.

A behavioral objective is one in which three conditions are stated: Points

1. The desired behavior is identified by name.	______
2. The important conditions under which it will occur are named.	______
3. The criteria of acceptable performance are given.	______

2. Score one point for each correct answer, minus one point for each incorrect answer.

a.	XX	______
b.	XX	______
c.		______
d.	XX	______
e.		______
f.		______

3. Score one point for each correct answer.

a.	L	______	e.	B	______
b.	B	______	f.	L	______
c.	B	______	g.	L	______
d.	L	______	h.	B	______

4. Score one point for each correct answer.

a.	F	______	f.	F	______
b.	T	______	g.	F	______
c.	F	______	h.	T	______
d.	T	______	i.	T	______
e.	F	______	j.	F	______

3

The Case for Programing

JOHN REDD, MILDRED BARNES,
AND A. BRUCE FREDERICK

The cardinal principle of programing has been described by Edward B. Fry as: "The student is the final authority in determining whether or not the program is good. In traditional curriculum materials an "expert" often determines the final presentation, but in programing, the approach is "student-centered." [1] It has been estimated that a good program requires 200 professional man-hours for each one hour of student programed material. The initial program is subjected to student scrutiny; it is analyzed and edited and revised many times until the majority of students are able to progress through the program successfully. A good program presumably will enable 90 percent of a student group to achieve satisfactory scores on a final test. While students may be classified as either fast or slow learners, depending on how far they achieve, the important point is that nearly all students who finish the program do learn. If a student fails to master the subject matter, it is assumed the fault is the program's and not the student's.

Uses of Programed Instruction

There are a number of purposes for which programed learning can be utilized. These include self-instruction, independent study, practice or drill, review of previously learned material, enrichment or advanced learning, and remedial work. A brief discussion of each of these factors follows.

Self-instruction and individual study: Programed instruction has been referred to as automated instruction, self-tutoring materials, and programed learning. Most of these terms imply the individualistic nature of the material. Programed learning provides for a close interaction between

[1] Fry, Edward B. *Teaching Machines and Programmed Instruction.* New York: McGraw-Hill Co., 1963, p. 3.

student and subject matter that may be compared with the interaction that occurs between a student and a tutor. Students work independently, with constant feedback and reinforcement, as they proceed through the material. The student is liberated from the lockstep of a heterogeneous class and moves forward at his own pace. Facts or concepts that may not be immediately pertinent to the student are probably best learned through programed materials. Such routine, cut-and-dried learning is done on an individual basis and classroom time can be devoted to more creative learning experiences. The teacher is released from much of the routine of rote learning to emphasize an individualized approach.

As leisure time increases, people will need readily available material for self-instruction and study. Programed instruction has already begun to meet this need.

Practice, drill, and review of previously learned material: The use of programed instruction for practice, drill, and for review of previously learned material is another advantage of this technique. Programs selected for the needs of individual pupils or special groups have been found to be more valuable than programs selected for an entire class. Students are provided with a store of basic and adjunctive information that may be discussed in class. Individually assigned programed exercises may also be given to some students to bring them up to the class level.

Enrichment or advanced learning: In any group there are some individuals who learn more rapidly than others. Programed instruction materials are useful in meeting the needs of these students by permitting them to move faster and farther in their learning.

This is an area of great potential for programed materials. The fast learner can proceed at his own rate and receive the challenge so often lacking with conventional techniques. The introduction of many innovations designed to enrich learning may be catalyzed through the use of programed instruction. Experimentation with nongraded classes, individually prescribed instruction, individualized scheduling, and other adaptations to student differences frequently utilize programed materials as one of several media.

Remediation: The use of programed instruction for remedial work is another important application. Students can be provided with another opportunity to approach subject matter in this new, exciting context. Troublesome areas may be programed as they become apparent. It is possible that over a period of time trouble spots may be revised to the extent that they may be included in the initial instruction and obviate the need for corrective measures.

Advantages

Research indicates that programed instruction can be an effective teaching device because of the following factors:

a. The built-in motivation of programed instruction maintains student interest and can increase the desire to learn because of the student's immediate knowledge of success.

b. Student errors can be reduced. Proper analysis followed by suitable revision of material can reduce errors even further during the learning process.

c. The learning capacities among students are leveled and differences become less apparent. Students in the lower portions of the class distribution tend to show more conspicuous gains in achievement.

d. Learning rates of students vary widely since students work at their own speed.

e. The predictability of individual success may decrease because slow learners may perform better with programed instruction than was indicated by their previous behavior on other methods of learning.

Research concerned with teachers and programed instruction indicates:

a. Over one-half of the programs in use are on a limited trial basis.

b. The majority of the programs in use are commercially prepared.

c. The junior high school (grades 7-9) appears to be the level of greatest exposure.

d. Mathematics has been the most widely programed subject; English, foreign language, social studies, and science have fewer programs.

e. About a quarter of all teachers surveyed are enthusiastic about this method of instruction; 50 percent respond favorably to it; the remainder are either neutral or opposed to it.

f. Different school systems of similar size and type, using the same program under similar circumstances, came up with quite different evaluations.[2]

Other studies have been conducted to determine the relative uses of programed materials and curricular adjustments.

At this time there is a lack of research in health and physical education. A review of literature indicates some activity among graduate students in universities. Several master's theses and dissertations have dealt with programed instruction, but these studies have been restricted to presentations of programs rather than an analysis of differences or comparisons of programs. (For a more complete review of the research in health and physical education dealing with programed instruction, see Chapter Five.)

The educational value of programed instruction has been well documented. The fact that students readily accept and profit from programed instruction has also been well established. Students have found that programed instruction enhances the learning of basic intellectual and motor skills normally taught by rote and through frequent drills. The self-motivating value of programed instruction is a built-in ingredient of a good program. The immediate feedback of responses and active responding is not only self-motivating but enhances the student's retention of the material.

The value of individualized instruction long has been recognized as an important educational approach. The introduction of autoinstructional programs has provided a much needed technique to implement this approach. The variations in the rate of learning any single unit of

[2] Center for Programmed Instruction. *The Use of Programmed Instruction in U.S. Schools 1961-62.* Washington, D.C., 1963.

material, as well as variable rates in learning different kinds of subject matter, is well recognized. Programed learning allows the student to proceed at his own rate.

One study of pupil-teacher relationship in regard to programed learning indicated that the most effective teachers in this area were those near retirement age. A possible explanation is that these teachers are no longer teaching classes, but are teaching students. These teachers, overjoyed to be released from much of the routine of exposition and drill, concentrate on enriching the progress of individual students.

The clarity of programed instruction, perhaps one of its outstanding advantages, is a result of the infinite care that authors must exercise in developing the program. The economy of programed instruction in terms of learning time and teacher efficiency as opposed to conventional materials has been readily demonstrated. This method increases the learning rate and proficiency of students.

Disadvantages

The primary disadvantage of programed instruction is the lack of availability of such materials. Hendershot has compiled a list of over 3000 programs that are commercially available.[3] Review of this catalog indicates that there are very few programs available in health and physical education. While little has been published to date, there is much activity in the field.

Cost is another disadvantage. Experts in programing have estimated that a year-long physics course would require approximately 15,000 frames at an overall cost of approximately $75,000, or $5.00 per frame. A geography program of approximately 900 frames was developed by teachers in the Newton, Massachusetts, schools at an estimated cost of $20,000

The time required for the preparation of a *good* program has already been referred to as enormous. Thus, it is not difficult to understand why commercially prepared programs are most prevalent in schools today. The inadequate subject matter coverage and poor programing techniques which characterize many of the commercial programs indicate that too many publishers are unwilling to spend the money and time required to produce good materials. Teachers hesitate to embark on such expensive and time consuming activities. However, with released time and professional assistance, teacher-made programs should be most effective in specific situations.

The dependence of programed instruction on the written word is perhaps a handicap for children with severe reading disabilities. It has been suggested that programs should be selected for the needs of the individual pupil or special group rather than for a whole class. If this procedure is followed, the child with reading difficulties would be given a program adapted to his level.

[3] Hendershot, Carl H. *Programmed Learning*. San Antonio, Texas: Trinity University Press, 1966.

Teachers have reacted in different ways to programed instruction, as might be expected with any new educational media. Some have resisted the use of programed instruction entirely and have indicated they are not convinced of its value. Others have plunged into the use of programed instruction without an adequate understanding of its use. The programed instruction material becomes another text or workbook in such cases.

It has been unfortunate that some teachers have selected programed materials that were poorly constructed and later rejected them with disgust. Teachers who have carefully selected short programs for a specific segment of classwork have been the most successful with programed instruction.

The advantages of programed instruction certainly exceed the disadvantages since the latter can be overcome with adequate planning and careful analysis of the problem.

Role of the Teacher

The purposes and values of programed materials may be somewhat overwhelming to the uninitiated user. Apprehension and fear are common emotional reactions to those who fail to recognize the limitations of programed materials. Certainly the advantages of programed instruction are multiple, but programed materials will never replace the teacher. There are too many things that the teacher can do that programed instruction cannot. While programed materials are most effective when they deal with factual knowledge, limitations are recognized when philosophical concepts are programed. Only the teacher can effectively help the student establish relationships and develop insights. In addition, the inspiration, motivation, and evaluation so vital to the learning process is initiated to a great degree by the teacher. Without this invaluable assistance, programed instruction would be doomed to failure.

With the use of programed instruction, however, the role of the teacher is altered. Some of his former tasks, such as lecture and drill, are minimized. Programed materials now assume the task of presenting knowledge and providing ample opportunity for practice and review. The time thus gained by the teacher can be utilized to aid, counsel, and guide students as they work at their optimum rate. The problems that students encounter can be resolved immediately. In this way each student will benefit from individualized, tutorial assistance. Is not time to perform this service what teachers have been clamoring for? If the program is assigned as homework, more class time can be devoted to discussion and further inquiry.

The importance of careful selection of appropriate materials cannot be overlooked. The objectives for a class must be determined and analyzed carefully before commercial programs can be evaluated adequately. Haphazard selection of materials can prove to be highly detrimental to the learning process. Not only must the program be selected for specific objectives, but it must be scrutinized in terms of the factors outlined in the programing process.

Students soon recognize that information that is programed is important and give it due emphasis. If outcomes for the course differ from what the student generally conceives as essential, then learning will be hindered to that degree. The students will learn the important facts only to the extent that they are programed. If final evaluation of student progress is based primarily on material other than that programed, minimal achievement should be anticipated.

Inability to find commercially prepared materials to meet the desired objectives may motivate teachers to construct their own programs. The programer soon discovers that preparing frames forces him to organize his material carefully in sequential order. It also draws him closer to the behavior of the learner and more clearly isolates for him the realities of the thinking process of the students. He therefore becomes more aware of the stumbling blocks in the learning process and can make adequate preparation to avoid or minimize them. Thus, not only does programing aid students to digest material, but it also enables the teacher to become more familiar with individual learning patterns.

Both the teacher and the student must understand and appreciate the purposes and uses of programs. Adequate time must be provided to orient both to programing. They must be informed that its purpose is to provide small bits of information in sequence and to repeat them as the nature of the material demands. This will produce overlearning and the attendant reduction of errors. Attention must also be devoted to instruction on the use of the program. If written instructions are not provided, the teacher should prepare them so that students have a clear understanding of how to proceed throughout the program.

Parents also need to be informed about the values of programed instruction. PTA meetings or open houses during American Education Week may serve as orientation periods. Parents must recognize that the steps are simple to reduce student failure and that the instrument is not created merely for novelty or for play; it is a valid educational tool.

The advantages of programed instruction cannot be underestimated in these times of mass education. Limited facilities and large classes should provide an exciting stimulus to the development of more and better programs. The question exists whether teachers are prepared to accept the challenge of adding new dimensions to their changing role.

Utilization in the Classroom

For the classroom teacher the opportunities for utilizing programed materials are numerous, the number being limited only by one's imagination. Presented below are some suggestions for utilizing programed instruction, but they in no way should curb a teacher's own creativity for exploring other uses.

Homework is one of the most common assignments for programs. It may be used either to prepare students for the subsequent lesson or to serve as a review for material covered in class. Generally, students prefer the former since the program usually gives an overview and isolates the important facts. Classroom discussion may follow with the instructor introducing material drawn from other references. All of this is followed by textbook assignments for more detailed study. Many teachers favor this method since it helps students learn the fundamental facts upon which further knowledge afforded by the text may be based.

A certain section of the program and designated pages in the text may be assigned for homework simultaneously. In this way the fundamental facts are emphasized and students learn their relationship to other facets at the same time.

If an appropriate textbook is unavailable, the program itself may serve that purpose. To supplement the program the teacher should prepare a current bibliography to serve as a reference for the students' oral and written reports. This method focuses on a more nondirected teacher-student relationship and places the responsibility for learning directly on the student. The instructor provides individual help and supplemental information through lecture.

In large classes with limited facilities some students may work on a program while others are engaged in other activities. Arrangement for equal distribution of time is necessary. Whether groups should divide a class period into activity and theory, or whether alternate days would be more suitable will depend upon the content and the length of the program and the local situation. For some programs it may be wise to have all of the students proceeding with the program simultaneously.

In situations in which classes are composed of heterogeneous grade levels (or abilities), or where students are in ungraded classrooms, programing will insure learners of a logical order of progression. Use of programed material will enable students to progress at their own rate and at their own level toward achievement of their specific objectives.

The course offerings in small departments, schools, or institutions may be increased by providing programed work in subjects beyond that offered in the regular curriculum. For areas in which there might be limited enrollment, programed materials could be obtained or prepared for students who express an interest in a particular subject. These students could attend a related class and receive assistance as needed from the instructor. Additional reading assignments and conferences or discussions with the instructor would induce proper learning. Not only could related subjects be introduced in this manner but also more advanced investigation in a particular subject area could be effected. For example, a kinesiology class could accommodate a group of students interested in the mechanical principles related to sports.

It is possible that extension courses could be programed at the college level. For students who are subject to long periods of absenteeism due to illness or accidents, programs may serve as a useful tool in helping them keep abreast of their school work. Completion of a designated program may be accepted in lieu of specific course work to demonstrate progress in a particular field.

It is clearly evident that implications drawn from theory and their application can be programed. Learning patterns can be improved with this kind of emphasis in physiology, kinesiology, and nutrition courses.

The same is true for applying rules and strategy in any activity in the curriculum. Rainy days provide an opportunity to continue the emphasis of the preceding class by applying theory in the classroom. For example, in football, what are the responsibilities for each player in a specific play? Under what conditions is an end run appropriate? In basketball, how does one beat a 2-1-2 zone defense? How does a player defend against the fast break? In softball, what is the best play when there are runners on first and third, one out, and the team is ahead 2-1 in the sixth inning with the seventh batter in the lineup coming to bat? Situations such as these can be established for any sport. With the background material provided by a program, students should be able to resolve the question or refer back to the fundamentals in the program.

Programed Movement Instruction

The *theory* of programed instruction and *specialization* are two basic prerequisites for those interested in programing movement. This book provides a basic course for the physical and health educator. References throughout provide excellent study materials. Selected ones should be consulted before any programing project is undertaken. If a course in programing instruction is offered, the beginning programer should take advantage of such an opportunity to further acquaint himself with techniques.

Secondly, the successful programer must identify his special strengths in physical education and limit himself to those. The objectives established for the programing chore must be highly specific. This demands thorough experience, including success and failure, in a specialty such as swimming, football, or fundamental movement. An experienced specialist knows when and how students will engage learning difficulties. Experience in the etiology and prescription of and for difficulties encountered in the learning of skilled movement are therefore basic prerequisites.

Teaching movement via programed self-instruction can be most effective in certain carefully selected areas. Programed movement, instruction (PMI) is a new concept in programing. Yet, as we begin to understand the intimacy between mind and body, especially the body's simultaneous participation in learning of all kinds by all of its parts, the idea can no longer be termed "impossible." Programed movement instruction not only shows promise but it has a distinct value in planning for progressive instruction in movement even when no written program results. Since this is a positive by-product it helps to justify the many hours that are necessary for planning and evaluating PMI.

Successful techniques which have been discovered for seemingly difficult motor problems are probably good raw material for programed movement instruction. The future success of work in this area will depend somewhat on the willingness to share tested ideas through publication and other means, thus building a backlog of off-the-shelf materials in programed movement instruction. Systems for retrieval of library materials are already in operation. It is only a matter of time before banks of materials in programed instruction will also be available.

If interaction of ideas is the goal in programed instruction, then certainly programed movement instruction has great potential in that the mind-body participation in learning is more obvious. How to provide immediate feedback for a motor performance is a relatively standard problem in program instruction. One simply provides written answers or criteria against which a performance is checked by the performer or a partner, or a visual means of evaluating the movement such as a mirror or T.V. replay, or some other self-checking device which the student may read or view. Immediate feedback for programed movement instruction can be accomplished in several ways but not quite so easily as in programed instruction.

It is quite important to devote a proper amount of time and care in the preparation of behavioral objectives. The terminal or subterminal behavior which the student is attempting to learn can be designed in such a way that either the student himself or a partner can evaluate and judge properly at each frame level. When appropriate, each frame describes exactly what is to be accomplished so there is no doubt in the mind of the judge. This aspect demands a little extra time by the programer but it is a very enlightening phase since there is quite a bit of student feedback when the directions are still in the shaping process and not finalized.

One of the first programed movement instruction programs in the United States—although it has never been identified as such—is the familiar assembly line method of swimming instruction advocated by the American Red Cross.[4] A beginner's class is typically subdivided into a number of teaching stations, each consisting of 3-5 learners who are assisted by a helper. The helper may be as young as twelve years old. Each station is characterized by an objective for the beginning swimmer. Once the learner is able to perform at the level expected, he moves on to the next station and so on until he has completed a beginner's test. An objective at one station might be to duck the entire face or head under the water. Performance can be easily checked by the teacher-assistant. Obviously, it would be foolish for each swimmer to have a written program in his hands unless it was waterproof. However, a publication containing frames does not make a program. Some alternatives will be offered later in this chapter.

As emphasized above, each frame must be specific in that details are outlined as to the degree and amount of assistance necessary for evaluation. At times none is needed; at other times it might be best to employ a team evaluation. Therefore, programed movement instruction is not often independently administered. This should not be regarded as a weakness. Working with others and all this concept entails has much to offer.

In such a situation the master teacher is released to supervise and advise rather than to assume the major burden for presenting information and evaluating students which is properly shifted to the shoulders of the students themselves.

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[4] American Red Cross. *Water Safety Instructor's Manual.* Washington, D.C., 1962.

Another major difference between programed instruction and programed movement instruction is attributed to the fact that the physical educator must deal with many more individual variables in motor learning as compared with classroom learning. These come into focus in the unique gymnasium-classroom. A leading internist psychiatrist, Edmund Jacobson, puts it this way:

> Every physical educator, I believe, should know that mental activity is basically muscular activity. If that's true, then as physical educators you have a big burden. You have not merely the preparation of the individual for physical fitness including skill in sports, but you've got everything to do with his mind as well![5]

Therefore, in addition to variations in IQ, experience, fear, anxiety, enthusiasm, and creativity, we in physical education must deal with a whole learner. In addition to the foregoing, we encounter variations in motor skill, strength, flexibility, agility, and body type—to mention only some major categories. The task of programed movement instruction is thus very challenging and worthy of the attention and skill of every physical educator. Humphrey,[6] Delacato,[7] and Kephart,[8] have suggested very strongly that perhaps the major contribution of motor learning is its affect in the conceptual realm. Learning, it seems, is never characterized by the absence of either concepts or the body's performers, the muscles. There are *no* closed circuits in the brain. It seems we in physical education are just beginning to understand our unique role in general learning. In the future, the classroom teacher will also begin to understand that the mind cannot be educated apart from muscle.[9]

One of the major procedures for the selection of problems for programed movement instruction is a thorough review of selected areas of specialization. The preparation of a model representing a field of study is often undertaken as a first step. In this way the programer tests the model to see if all components of the selected field are represented. For example, in gymnastics we might evolve the model shown in Figure 1. The five symbols represent the major subdivisions of this activity. Under each subdivision is a list of selected categories. These represent the scope of each subdivision although they are not expanded technically due to limitations of space. The experienced teacher of any specialty will tend to expose certain motor difficulties which are not easily learned by a majority of students. This may be true even when such skills are not

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[5] Jacobson, Edmund. Quotation from a speech delivered to the Physical Education Division of the Eastern District of the AAHPER Convention at Atlantic City, April 22-25, 1966.

[6] Humphrey, James H. "Reading and Physical Education." *JOHPER* May-June 1959, pp. 30-31.

[7] Delacato, Carl. *The Treatment and Prevention of Reading Problems.* Springfield, Ill.: Charles C Thomas, 1964.

[8] Kephart, Newell. *The Slow Learner in the Classroom.* Columbus, Ohio: Charles E. Merrill Books, Inc., 1964.

[9] Steinhaus, Arthur. "Your Muscles See More Than Your Eyes." *JOHPER* September 1966, pp. 38-40.

classified empirically as difficult by experienced teachers. They are knotty problems one might find in any field.

We know, for example, that a handstand is not commonly performed by a majority of students in our classes. It is suggested by those with limited experience in gymnastics that the handstand is advanced work. The momentary handstand (where the position of the handstand is shown but not held) is also infrequently performed by the simple majority of a typical class and yet this position has been recommended as a lead-up to the performance of a cartwheel. We may surmise that the teaching and learning of handstands could be more efficient. Perhaps programed movement instruction might show positive results.

After carefully selecting those problem areas of a specialty which seem to be promising raw material for programed movement instruction, what is the next step? Our motor learners come to the gymnasium with diverse differences, and they already possess varying degrees of skill in the performance of selected movements. The station method incorporated into programed movement instruction was devised purposely to place students at appropriate starting levels. This is not to infer that students should not practice skills they already have. We are simply concerned here with efficient methods for acquiring new skills.

To use the station arrangement, the teacher must administer a pretest to determine more or less precisely the level of each of the students who engage in programed movement instruction. This pretest is devised to separate learners for specific work, in this case the performance of a handstand. Accordingly, stations representing subterminal behavior with respect to the handstand are defined. The combined number of stations represent a continuum for the handstand or hand balancing in general. The continuum must be comprehensive enough to accommodate the great variety of learners alluded to above.

Prior to their participation in programed movement instruction, the students are sorted and placed properly at one of the stations. Often the student can do this himself. The teacher should circulate through the class to help each member determine his status. The objective is to have the student enter a station that represents his highest attainment within the continuum. Thus the obese student may enter the program at a very low level whereas the child who already performs a held handstand is placed at a much higher level. Once this phase is accomplished each student will be attempting to reach the next highest station.

When a student enters at Station 3 his terminal behavior objectives will be to reach Station 4 or any other station above this number. Those who are familiar with the program offered by the Royal Canadian Air Force[10] will be somewhat familiar with the progressive nature of a station-oriented program. Stations should not be skipped unless this is specifically advised by the programer. If feedback indicates that a certain station should be eliminated or modified, the program should be readjusted. The student must be constantly aware of his next step. If he becomes confused, he must seek advice and guidance from the teacher.

[10] Royal Canadian Air Force. *Royal Canadian Air Force Exercise Plans for Physical Fitness.* (XBX and 5BX) Revised Ed. Pocket Books Inc., 1962.

Thus the burden for learning is on the student. How different this is from the traditional style of teaching in which the obese student simply cannot perform but the skilled student is often asked to demonstrate and thus learns nothing new. The average student in such a class simply follows directions supposedly designed for this mythical group. Progression is often inefficient and there is little or no chance for creative movement or movement exploration.

Programed movement instruction also differs from traditional instruction in that it is ungraded. If a student reaches Station 2 at the end of grade seven he begins at this level in grade eight. Another student may be found at Station 5 in the third grade. Our present example of hand balancing might well apply to this situation. With an ungraded approach current curriculum guides would seldom apply since in the majority of these publications specific work is outlined to be taught at each grade level.

Even if the programed movement instruction approach were never adopted, there would be advantages to thinking through activity areas in the manner outlined above. The result would be sets of continuum which would help each teacher to be aware of next steps. Knowing what comes next is a cardinal principle of PMI. An experienced teacher plans or uses a continuum (in this instance for hand balancing) and then, through careful observation, makes judgments about progress at each station as well as judgments about general class progress. Each class will be found to differ from every other class. Suddenly the teacher finds that he need not repeat the same thing over and over again but is released to attack specific learning difficulties within each station for each student.

It serves no useful purpose in this presentation to present the entire handbalancing continuum. Therefore, we have simply listed some of the tasks which may be presented at some of the stations, and then specifically examined one of these stations and its content.

The Handbalancing Continuum

The stations outlined below for the learning continuum in handbalancing have been selected empirically. Tasks listed under each station are representative suggestions or objectives derived from the finished program. Specific PMI frames will follow the outline to give the reader a small portion of the final or working format of the program.

Station 1. Experience in a variety of hand-supported movements

A. Show ten different movements in which there is a shift of weight from one part of the body to the hands.

Note: Cards showing positions may be used for stimulating purposes if the group at this station seems "lost."

B. Performance of simple locomotor stunts with an emphasis on hand support.

1. Seal walk
2. Wheelbarrow (with partner)
3. Forward roll

Note: Those learners who exhibit fear or have no experience in rolling should be shunted off to work on movements leading to skill in this area.

C. Elementary vaulting. (Experience in vaulting over low objects with an emphasis on momentary hand support.)

Station 2. Execution of a hand and head balance (headstand) and other momentary hand balances or supports

A. Students are to show at least a head and hand balance where the base is well established and the knees are placed comfortably on the arms.

Note: If it is apparent that there is no control or experience in the head and hand balance, students are again shunted off into a separate program.

B. Transfer of weight from knees to hands. Students show progressively more control on the hands before returning to the knees.

C. Frog balancing. Control is not expected at this Station.

D. Continuous vaulting over low apparatus where hands remain in contact and students show an increasingly slower execution.

E. Casting away from a low horizontal bar to a momentary free support. Again the objective is to show a slow, well controlled transfer of weight to the hands.

F. Cartwheeling of a very elementary nature. The coordination is shown but there is no attempt to show extension. The feet are very close to the floor and the movement is performed without obvious noise from either the feet or hands.

G. Jumping to hand support on parallel bars adjusted to the height of the student's waist. Students are not encouraged to walk along the bar rails in support. The only objective is that they discover the feeling of support from a small jump. (Handwalking on the parallel bars serves no useful purpose; often it results in a sudden collapse. If shifting weight in hand support is an objective, it can be safely accomplished on the mats.)

Station 3. The development of a very simple composition in which ten different kinds of movements resulting in hand support are joined together with suitable connective movements. Combinations of apparatus (student's choice) and the floor are possible with at least two movements involving apparatus

Note: The teacher will encourage movements that are suitable for the individual. Low beams, low bars, or chairs may be arranged by the students to accommodate their composition. Emphasis will be focused on simplicity, lightness, and continuity.

Station 4. Performance of elementary controlled balances

A. A special lesson at this station involves a general concept of balance. (The broader the base of support, the firmer or more controlled the balance.) Since the emphasis here is on handbalancing, the students are led to discover the ideal shape of the hands for controlled balances. Homework might be assigned in which the student (using water color or stamp pad ink) makes impressions on paper while supporting his weight on hands and feet. The student who understands the concept will be able to elect the hand position shown in the diagram. Assignment sheets are prepared in advance.

B. Frog stand. Student demonstrates proper hand shape for maximum control.

C. "L" stand. Once again hand shape is an objective. Students may elect variations of this balance since the abdominal muscles are especially involved. The tuck position shown in the diagram is least taxing in this respect.

Station 5. Momentarily, extended-leg handbalancing is engaged. Partners are employed to learn and practice safety techniques

A. Kick-ups with one leg fully extended. Partner uses a single, open hand (palmar surface) to arrest movement which tends to overbalance the performer forward.

B. A controlled handbalance with one leg extended—"getting stuck."

Note: The first performance of this balance will be an exciting experience for the student. He will have learned that balancing on the hands is possible for him, and progress will proceed more rapidly for a while. The teacher must understand that there is commonly a learning plateau preceding the first successful attempt at this station.

C. Demonstrate a roll-out and a step-out with assistance from a partner. One leg is extended.

Special note on arm extension: Beginning with Station 5, all balances should be characterized by straight or "locked out" arms. Balance can be controlled by bending the arms but this is inefficient and tends to slow down the learning process and also forces hypertension in the spine, thus further complicating control.

Station 6. Momentary handbalance (two legs extended) showing unassisted step-out and roll-out

Note: At this station the teacher will check further progress in the fully extended, well performed cartwheel. The cartwheel should be perfected at this level of skill and the teacher may wish to shunt off into special practice those who are not able to demonstrate this movement.

Station 7. Partner-assisted handstand. A. Student is able to show control when his partner assists him by no more than two index fingers which are used to tap the performer into momentary control. B. While practicing, the performer is encouraged to feel the action of the hands which are conditioned by the tapping action of the assistant. C. The assistant will learn to tap while watching the performer's finger action and reinforce his learning by giving him verbal directions about his hand position

Note: The skills of assistance and performance are of equal importance at this level since they tend to reinforce each other.

Station 8. Student demonstrates controlled handstand with fully extended body. In kicking up to a handstand the student is able to demonstrate control in a given number of trials

Note: For example, the student will demonstrate six controlled handstands from kick-up out of ten trials. He continues to work with a partner.

Station 9. Exploration in controlled handbalancing

A. Movements of the legs while in a controlled handbalance.

1. Kicking in the air.
2. Straddle position.
3. Stride or splits.
4. "How many ways can you move your legs?" (Diem approach [11])

[11] Diem, Liselott. *Who Can . . .* Frankfurt, Germany: Wilhelm-Limpert Verlag (English Text) 4th Ed., 1964.

B. Handwalking. This is normally discouraged in the quest for controlled handbalancing but since it is fun and will motivate the skilled performer, this is the time to do it. Handwalking is easier than handbalancing, therefore, it may possibly be learned prior to the controlled balance.

C. The ball-up handstand is an objective at this station. In performing the ball-up handstand, control is maintained all the way to the extended position. It may be classified as a strength handstand and will be learned prior to the introduction of other, more difficult strength-oriented handstands.

Station 10. Fully extended, apparatus handstands with an emphasis on low parallel bars

Note: The general pattern follows the example cited in Station 7. The difference will be noted in the hand control since the hands are grasping the rails rather than fully spread. Fingertip action is accordingly not felt. Rather, the performer will learn to feel appropriate pressure of his hands against the rails and how this pressure results in controlled balance.

Station 11. Further development of strength handstands

A. Straight arms; straight straddled legs

B. Straight arms; straight joined legs

C. Straight body; bent arms

D. Straight body; straight arms

E. Same progressions on parallel bars and other selected apparatus.

Station 12: Unusual advanced handbalancing

A. Cast to a handstand on the low horizontal bar.

Note: Although balance on a bar is very difficult to maintain due to the limited action of the hands, the object is to obtain a position perpendicular to the floor in preparation for giant swings.

B. Vault to a controlled handstand on the long horse or vaulting box.

C. Diving (variations) to controlled handstands on the floor.

D. English handstand (beam or parallel bar rail).

E. German handstand. This may be performed on the floor or on the apparatus. It is characterized by the head held down between the arms.

F. Yogi handstand.

G. Planches (front and rear)

Station 13. The development of a controlled balance on one hand

A. Demonstrate a shift of weight while in a controlled handstand.

B. Demonstrate a very light tapping action of the nonpreferred hand while balance is maintained on the preferred hand.

C. Demonstrate control on one hand while making adjustments with one finger of the nonpreferred hand. The legs are straddled for added control (much like the control of the tight-rope walker's pole).

D. A controlled one-hand balance. The nonpreferred hand is held out to the side and is free of the floor.

E. Progression is attempted on the low parallel bars.

Note: The learner is apt to find once again that balance is somewhat easier to control on the parallel bars.

PMI for Station 5

Prior to their entrance at Station 5 the learners will have demonstrated the behavior required in all previous stations. They will have had experience transferring their weight to the hands and they will know how to shape their hands properly for handbalancing.

They now become familiar with the terminal objective for Station 5. This can be accomplished through the use of charts, films, or an actual demonstration. If this program is being used for the first time, the students are told that they must proceed one frame at a time and they are encouraged to perform all of the actions indicated. If they work with a partner, they will function as a performer, an observer, and judge. At the beginning of the sequence they are asked to read the following:

> *To the student:* You have now begun your work at Station 5 of handbalancing. There are eleven action steps to be accomplished. At the end of the tenth step (frame) you will have held at least one extended-leg handbalance. This action will be your ticket to Station 6. Some of you will proceed slower than others. There should be no rush to keep up with your partner or others in the class if they are going a little faster. If you finish these frames today that's fine. If not, that's O.K. too!

The student chooses a partner and begins the program. In some cases the teacher will discourage partners of vastly differing sizes and abilities from working together.

Current Experience in PMI

The PMI sequence presented above is not perfect. In some ways it is like an unfinished statue. The fine abrasive necessary to polish it has yet to be applied. The proceeding sequence represents the fourth revision of the original program which was empirically ordered. Deleted from the original form were frames about the mechanics of balance and references to certain angles formed by the straight leg and the trunk. The inclusion of these items made sense to the programer, yet some college students were confused when confronted with this.

The programer exhibited the normal tendency of an experienced person to include more material than is necessary to bring about the desired end behavior. It is difficult to assume the role of the learner but it is worth the effort to find out exactly where these learning difficulties do appear. The programer finally realized that *he* had not learned the mechanical aspects of handbalancing until years after he had had the concomitant movement experience. He had defied his own model for balance in which conceptual material is suggested after practice. If conceptual material is presented in advance, one may expect the learner to be confused by it or to forget this material rapidly regardless of the value it seems to have at the time. After a reasonable amount of work in balance conditioning has taken place, those ideas which will lead to the formation of concepts may be inserted. This latter work is of a higher order and will eventually lead to those deeper meanings for which education strives.

With further refinement the sequence example above will be changed so that an earlier emphasis on straight ("locked out") arms will be moved up in the frame order. The role of fingertip pressure in preventing overbalance and preserving balance in the extended-leg handbalance position will be expanded into several new frames.

What is the finished product? A learning tool; an aid to the teacher who has the foresight to take advantage of its strength.

Through programed movement instruction, regardless of the form of presentation, the teacher may learn much about specific motor activities and the ways in which students learn to perform them.

Use of PMI often results in a better oral presentation or "programed lecture," of a skill in the gymnasium environment. However, it will be some time before radical departures from the design of current teaching stations may be seen.

Through programed movement instruction it may be discovered that the traditional controversy surrounding "whole-part" learning versus "part-whole" learning is not as important as the actual definition of these terms. To some learners the teacher's "part" percept may represent a student's percept of a "whole." A "part" of a headstand might be perceived when a student simply forms a base and, after some practice, is finally able to get both of his knees up on his arms. The "whole" percept headstand has been the classic extended-leg position. It is quite possible for the learner to think in terms of two "wholes" when he is confronted with these two balances, one easier than the other. When he accomplishes the easier of the two he is actually able to do a whole thing.

4

Format and Hardware of Programed Instruction

EINAR A. OLSEN

Programed instruction emphasizes the particular advantage of giving each student individual attention. This tutorial learning device tailors instruction by allowing each student to proceed at his own rate in completing specific material. Programed instruction refers to any form of preprepared, presequenced instruction directed toward a specific educational or training objective.[1] The device may take the form of a textbook or it may be a simple file folder; a cardboard box in which the "program" is exposed through a slot; a simple machine or a complex computer-based system utilizing multiple audiovisual techniques.

Many of today's programed materials are available in textbook form and, generally, these look much like ordinary texts, workbooks, or instructional kits. Programed texts are relatively simple types of programed devices. Two types are available. The most popular are the sequentially programed texts with formats developed by Lloyd Homme and Robert Glaser and content based upon B. F. Skinner's constructed response theory. Also used are the scrambled books developed by Crowder. These use the student's response to a multiple-choice test item to determine whether the student has grasped the content and whether or not he needs review or reinforcement.

Horizontal format texts. Making use of Skinner's constructed-answer type of response (completion of a statement), the horizontal text usually presents instructional material and questions on pages separate from the answers. The frame is presented on the top of the page. After the student makes his response below the frame, he turns the page for the feedback of the correct answer which is usually located at the top of the second page. He then proceeds to the third page for the next question, and to the following page for the appropriate answer. To reduce the number of pages in the text, the correct answer may be presented on the back of the page which presents the question.

[1] From Hughes, J. L. *Programed Instruction for Schools and Industry.* Chicago: Science Research Associates, 1962, p. v.

Some horizontal texts contain material at various levels of difficulty. This allows the brighter or faster student to work through the program in larger steps while the student who has more difficulty may be referred to areas of the test which contain more information and explanation.

Vertical Format Texts. The vertical format has more recently become popular as a programed text. This design presents the correct answer either adjacent to or beneath each question, thus negating the necessity of turning the page to locate the correct answer. However, it does necessitate the student's voluntarily covering or disregarding the answer as he reads and studies the question. This design also makes it easier for the student to refer to a previous question for purposes of review.

Commercial programed materials, such as Blumenthal's *English 2600* published by Harcourt, Brace, and World; McGraw-Hill's *Using Mathematics;* Science Research Associate's *Reading Laboratory*, are available to those seeking examples of vertical format texts.

Scrambled texts. The scrambled text was developed by Crowder for multiple-choice responses and branching programs. The frames, unlike other formats, are not sequentially presented but are randomly scattered throughout the text. The first frame is presented on the first page of the text and the student, after reading the information and the question, selects his response to the multiple-choice question. To check his responses he is referred to another page. If his answer is correct, he continues on that page with the next frame in his branch or route. If his answer is not correct, he is presented with additional information and then referred to the original question in order to choose another response. The *Manual on Venereal Disease Education* published by the American Association for Health, Physical Education, and Recreation is one example of a scrambled text. Crowder's own Tutor-texts represent the most substantial production of scrambled-text programs.

Programed texts have the advantage of simplicity of use and ready accessibility. The student and the instructor can shift from one text to another quite readily. In a classroom the students can refer easily to the same page, making group presentations less complicated, or they can work individually. Texts are relatively inexpensive.

Some studies have revealed that programed texts have some disadvantages as well. They often have restricted use in a school. Material does become outdated and some programs are used only once, especially if students are allowed to write their answer directly in the book rather than on separate answer sheets. Unfamiliar formats may easily distract some students and may require careful and explicit directions by the teacher. Students and teachers are also able to violate the learning sequence of the programed text by straying away from, or taking short cuts in, the program. Experience has shown that some students may not cover the answers and are able to move ahead through the material with no guarantee that learning is taking place.

Hardware of Programed Instruction

Teaching machines are mechanical or electronic devices designed to present self-instructional programs to a student.[2] They range from the relatively simple Skinner box to complex mechanical or electronic systems which use a variety of auxiliary units such as tape recorders, talking typewriters, 35mm slide projectors, movie clips, calculators, computers, and TV video recording. Any publication describing these teaching machines is soon obsolete because of the rapid developments in the production of such "hardware." While industry progresses to the fourth and fifth generations of computer systems, educators are still developing programs and new uses for the devices of the first generation.

The real development of teaching machines came after the Second World War under the guidance of B. F. Skinner of Harvard University, who had found experimentally that learning was best achieved by careful and selective rewarding or reinforcement.

Most teaching machines apply the same principles of reward and reinforcement. One of the early teaching devices was the manually operated slider machine developed by Skinner. The student responded to a question, which was presented through a small window in the machine, by moving sliders containing numbers or letters to produce the correct answer. A disk-type machine, also developed by Skinner, made use of a rotating disk on which questions and programed material were printed. The disk rotated until the questions appeared in a slot. The student then made a response.

Various commercial types of machines built upon those early principles are now used in schools throughout the country. The typewriter-input machine, made by IBM, combines a digital computer and an electric typewriter input. This machine feeds questions in a predetermined order, the student types his response, and the computer indicates within seconds whether the response was correct. These teaching devices, like many programed textbooks, are constructed-response devices making use of the same sequence: exposure of the question, student response, exposure of the correct answer, and the presentation of the next question in the sequence. This procedure is also used in the flashcard technique of learning often used in mathematics.

The Brentwood School in Palo Alto, California, is working with the IBM 1500 Instructional System, using it as a teacher substitute for individual learning. Palo Alto also has developed, with IBM, experimental computerized curricula.

Other commercial teaching machines utilize multiple-choice response programs. As in the programed text, it is easy to produce branches for each response. This more detailed program makes greater allowances for the student's own rate of learning. Even nonmechanical devices such as Pressey's punchboards and Bryan and Rigney's tab system make use of multiple-choice response technique.

The Welch Auto Tutor utilizes the tutorial branching-system approach which presents instructional material via a program. Several filmed

[2] Jacobs, Paul I.; Maier, Milton H.; and Stolurow, Lawrence M. *A Guide to Evaluating Self-Instructional Programs.* New York: Holt, Rinehart, and Winston, Inc., 1966, p. 15.

programs are available. These are composed of explanatory text together with multiple-choice questions to evaluate achievement and understanding. Should the student response indicate the need for extra remedial work, "wash-back" sequences are provided. Conversely, correct responses allow the student to move ahead, passing over material already mastered.

Recently developed multiple-choice machines make use of both aural and visual stimulations. Hughes Aircraft Company developed the Videosonic which combines a standard 35mm slide projector and a standard tape cartridge. Programed materials may be aural, visual, or a combination of both. This flexibility of stimulus choice is especially useful when testing illiterate persons or young children who do not read well.

Two of the largest, noncomputer teaching machines are the Mark I and Mark II Auto Tutor, developed by U. S. Industries, Inc. The Mark I and II have greater sophistication than most noncomputer machines because the program can adjust to the student's response much like the scrambled-text program. The machine utilizes microfilmed printed materials, motion picture slips, audio tapes, and 35mm slide materials. The Mark I has a recording device which tabulates item response patterns and speed of each response.

The development of audiovisual systems combining various means of information storage with several forms of retrieval devices opens unlimited possibilities for education. Most of the storage-retrieval systems are designed to supplement regular classroom presentations, but a few, such as the system at Grand Valley State College, and Oral Roberts University, are designed to serve as the major teaching-learning technique.

Information-storage and retrieval-and-distribution systems utilize several familiar audiovisual devices: audio and video tapes, 16mm motion picture film, and 35mm slides. The system usually has capability for closed-circuit TV and receiving or distributing radio and television broadcast signals. When all of these media are brought together into a coordinated system, the potential for educational use by faculty and students is limited only by the imagination of the users. The system approach is well-suited to accommodate programed materials, but few programs have been developed which utilize the existing potential.

The ultimate in teaching machines for programs is the electronic computers. The computer, used principally to control branching programs, presents questions and informational material via television. Student responses are typed on an electric input typewriter and fed into the computer, which then may present the student with a remedial item or may send him through a sequence of supplementary items before he returns to the main program. For review and further study, the student may also be presented with items previously presented.

In computerized teaching devices the student's response determines the next presentation by the machine. The machine may present instructional items which need no response, or it may present items which do require a response before the student continues. With some programs, the student is able to indicate which items he wishes to restudy and the machine then presents those particular items.

The computer can be programed to maintain a record of answers and responses of each student and make them available to either student or teacher whenever they are wanted. Newer computers have now been developed which respond not only to typewriter input but also to light-sensitive pens touched to the television screen, and to direct-voice inputs. Most computers are able to control separate units of still and motion pictures, along with other audiovisual presentations. Programed materials are easily updated by addition of new slides, film clips, or information.

An explanation in greater detail of the *Plato I, II,* and *III* series, the *Socrates* and *Class* systems, and the *IBM, Cobis,* and *Stanford I* computers is offered in Garner's [3] *Programed Instruction.*

Computer-based educational systems have been drawing some of the biggest industrial names into the business of education—names such as Philco-Ford, International Business Machines, General Electric, Radio Corporation of America. McGraw-Edison is presently producing "talking typewriters" which are in use under laboratory conditions and which are also being tested in Chicago's Project Breakthrough program. The machine flashes a picture on a screen, identifies it with careful enunciation, and guides the student into spelling out the word on a keyboard. Two such machines are being used and tested in the Berkeley, California, schools. The newest model of the talking typewriter, the Mark IV, is being produced by the Responsive Environments Corporation.

In the fall of 1967 the Philadelphia Public School District began Project Grow using Philco-Ford hardware consisting of a centralized computer system, four remote computers, and forty-eight student television-keyboard terminals.

RCA, in February of 1968, began a fifteen-school test system in New York City. It will eventually serve more than 6,000 students in individualized and specialized arithmetic, spelling, and reading. While the rest of the class works "live," the RCA TV-tube terminal tests one pupil.

A perusal of recent publications and of manufacturers' literature shows the availability of a wide range of hardware adaptable to programed learning experiences. While the manufacture and distribution of hardware is progressing at a startling pace, the limitation on programed learning will continue to be the development of sound, effective "software."

[3] Garner, W. Lee. *Programed Instruction.* New York: The Center for Applied Research in Education, Inc., 1966, pp. 89.

5

Pioneer Programing Efforts

LOREN BENSLEY AND THOMAS EVAUL

A review of what actually has been programed in health and physical education reveals that very little has been done. Published materials currently available for purchase are quite scarce and in most instances, depending upon specific need and grade level, are nonexistent. A number of studies are being conducted which, hopefully, will make satisfactory programs available in an increasing number of subjects.

Health Education

At the present time, very few programs concerned specifically with health education have been published. The greatest effort has been made by the Behavioral Research Laboratories, Palo Alto, California, which in 1964 published *The American Health and Safety Series* consisting of six programed tests: first aid, safety, nutrition, personal health, body structure and function, and prevention of communicable disease. The series, designed for use at the junior high and secondary school level, is most complete and can be used as an entire course or as selected units in a health education course.

More recently, a program on venereal disease education has been written by William F. Schwartz, Educational Consultant to the United States Public Health Service. The program, entitled *Facts About Syphilis and Gonorrhea,* is written for the junior high and early secondary school student, and uses the extrinsic technique of programing.

Food-Borne Disease Investigation: Analysis of Field Data, a booklet published by the Communicable Disease Center, USPHS, presents a salmonellosis investigation programed with use of a wide variety of pictorial, mathematical, and graphical, illustrations which blend together in an exceptionally instructive manner.

The aforementioned programs are the only known programs that have been published in health education. There have been, however, a multitude of programs published in the related health fields. Programs are available in human anatomy and physiology, driver education, physical education, medical terminology, and pharmacology.

A number of recent doctoral and master's theses, especially those by Helen L. Tinnin,[1] Ruth E. Tandy,[2] and Lee Avner,[3] present effective research on programing in health education. While not published commercially, it is hoped that these might become available in the near future.

Physical Education

The implementation of programed instruction in teaching physical education has been slower than in most of the traditional classroom subjects. A survey conducted in 1963 by the Programed Instruction Committee of the AAHPER Physical Education Division yielded only six replies and one commercially published program. A repetition of this survey in 1966 produced over 25 replies and, while only two additional programs had been published, a number were being developed, tested, and submitted for publication.

There are many reasons why physical educators have been slower to pioneer the use of programed instruction, the foremost reason being the lack of programs on the market. Few people have developed programed materials in physical education, and commercial firms producing programs have not been eager to venture into this unknown market while being fully occupied in other academic fields.

Several factors underly this lack of programs. One is the time consumed in writing such programs. As will be seen in Chapter 7, writing an effective program requires considerably more work than producing text books and other types of instructional materials. Not only must one learn the techniques of programed construction, but he must have a thorough knowledge of the subject and of the most effective method of teaching it. Developing a good program also requires a vast amount of patience. Physical educators are generally activity-oriented and not interested in the tedious task of constructing instructional programs.

A second reason why there are few programs in physical education stems from the nature of the subject matter. The bulk of the content in this field deals with motor skills which do not lend themselves easily to programing. Most teachers have traditionally taught such activities by demonstration, films, and similar visual and verbal means. It has been difficult to visualize how such skills could be taught by programed instruction.

The so-called "knowledge" component (rules, history, benefits, etc.) generally consumes a small portion of time in the typical activity class and, therefore, it has not seemed worthwhile to invest a great amount

[1] Tinnin, Helen L. *The Development, Standardization, and Pilot Testing of Instructional Programs in Health Education on the Topic of Cigarette Smoking.* Unpublished doctor's thesis. Columbus: The Ohio State University, 1964.

[2] Tandy, Ruth E. *Effects of Programmed Instruction on the Attitudes, Behavior, and Knowledge Regarding Smoking Among Selected Seventh-Grade Students.* Unpublished doctor's thesis. Columbus: The Ohio State University, 1960.

[3] Avner, Lee. *A Pilot Study Involving the Development, Presentation, and Evaluation of a Programmed Text in Sex Education for College or University Students.* Unpublished master's thesis. Denton: Texas Women's University, 1966.

of time in program preparation to cover this aspect of a course. Since it seems more logical to program knowledge rather than activities, this was the area in which the first programs were written. Recently, however, several programs have been developed and used successfully in teaching motor skills.

Even if there were adequate programs in existence, another drawback unique to physical activity would inhibit their use. The settings in which physical education is conducted (the gymnasium, playfield, and swimming pool) are not conducive to the use of programed materials. Teaching machines, programed texts, and computers would be too awkward to use in such environments.

Despite all of these problems, the numerous advantages of programed instruction, and the effectiveness of such materials in improving instruction in other fields, have begun to motivate the development and/or use of programed instruction materials and techniques in teaching physical education. Programs have been developed and utilized to teach various aspects of activities at both the high school and college level as well as in the professional preparation of teachers.

One of the functions which can be served by a program is learning the rules of a specific activity. Many schools, faced with a lack of facilities and time for physical education classes, could utilize classrooms or out-of-class study assignments with such programs rather than take activity time and space to teach rules.

Programs have also been written to teach various background concepts of physical education in general and certain specific activities. The effects of exercise, the history of sports, and the principles of movement are areas that lend themselves well to this type of treatment. The first commercially produced program in physical education, *Physical Education For College Students,* by Penman, represents the type of program designed to perform this function.

Game strategy is another area in which some programing has been done. Position on the field or court, desirable plays or movements to take optimum advantage of a situation, and general principles of play are concepts that may be acquired through study as well as through experience.

The field of testing offers a unique opportunity to use programed instruction materials. The purpose of a test, directions for taking it, and the interpretation of the results are factors often covered hastily in activity classes. A program that would enable students to develop an understanding of these concepts could make a considerable contribution to more efficient and effective testing. The only program known to serve this purpose is one on the Fleishman Physical Fitness Test by Vidola.

As difficult as it may be to conceive, the area of skill development is one which offers a great deal of potential for programing. The challenge of programing motor activities has stimulated several people to attack this problem. Programs in golf by Adler, in tennis by Farrell, and in modern dance by Mell, exemplify this area.

Physical activities is not the only area in which programed instruction has been used. The professional preparation program in which teachers are trained offers vast potential and several examples of programed materials. *Physiology of Exercise,* a recently published programed text by Clayton, exemplifies the use of this technique for preparing teachers. Programs in the basic sciences, statistics, and other related areas are currently available for use in this aspect of the curriculum, too.

Although considerable research has been done in the field of programed instruction in general, work in the area of physical education has just begun to get under way. Very little can be found in the literature concerning research in this area. Most of what has been done is not yet published.

Norman Veach conducted a study comparing programed materials and a conventional book on the learning of football rules.[4] Using the results of a pretest, he divided a high school football team into two equivalent groups. One group studied the rules from a traditional book while the other used the programed material. While both groups showed significant gains in learning, the program group was significantly superior in performance on the post-test to the textbook group. In addition, the students' reaction to the program was quite positive and the coaching staff noted a reduction in major penalties during the season.

Jack Adler conducted a study to determine the effectiveness of a program on teaching the iron swing in golf.[5] Following a pretest on the iron shot, the control group was taught by lecture, demonstration, and individual help, while the experimental group used the program. The results of a post-test revealed that the program group had achieved significant improvement while the other group had not. Furthermore, when the subjects were classified into three groups on the basis of initial scores, those in the top and bottom third of the experimental group had improved significantly more than the corresponding control groups. A favorable attitude toward the questionnaire was shown by the program group in a post-experiment questionnaire.

Shirley Mell designed a program to teach elements of modern dance.[6] All students were given the first lesson at the same time but proceeded at their own rate after that. As a result of instruction through the program, they learned the fundamentals of modern dance and were able to express ideas through movement.

A progressive task-solving program for tennis forehand and backhand drives was developed by Joan Farrell.[7] After pretesting, two classes

[4] Veach, Norman C. "Programed Instruction of Football Rules." *The Physical Educator* 24: 121-122, October 1967.

[5] Adler, Jack D. *The Use of Programed Lessons in Teaching a Complex Motor Skill.* Unpublished doctor's dissertation. Eugene: University of Oregon, 1967.

[6] Mell, Shirley A. *The Design, Administration and Evaluation of Auto-Instructional Modern Dance.* Unpublished master's thesis. Knoxville: University of Tennessee, 1966.

[7] Farrell, Joan E. *An Application of Programed Instruction to the Perceptual Motor Skill of Tennis.* Unpublished study. Ann Arbor: University of Michigan, 1966.

received instruction via the program and two by the teacher-directed method. An analysis of the post-test showed the two instructional methods to be equally effective, with both groups making significant gains in performance of the two skills. One of the primary advantages observed in the program was that it permitted each student to progress at his own rate.

At the time of this writing, these are the only research programs known to have been completed on programed instruction in physical education. Undoubtedly, the rising interest in this technique will stimulate more activity in this area and enable us to better evaluate the effectiveness of this technique and the best ways to use it.

6

Other Uses of Programing Theory

THOMAS EVAUL

Programed instruction is not the panacea for all educational problems, but the underlying theory and the results of research utilizing programed instruction have revealed considerable information and several principles that can be successfully applied to other forms of instruction.

Three important elements of programed instruction have implications for the instructional act in general. First is the statement of objectives in behavioral terms. The concept that learning is a change in behavior has forced teachers to consider what type of behavior they are trying to develop in their students. The identification and precise statement of these goals, which was discussed in Chapter II, is a necessity when developing a program and would seem to be equally important in other types of instruction.

A second important element in programed instruction is the overt responding, on the part of the learner, to questions and problems posed in the program. Only by the student's response to the learning act can we determine whether or not he is learning. If his performance is correct, it can be reinforced. If it is not, it can be extinguished. It is this process of "doing" that both causes and demonstrates learning.

The third important factor in programing that has implications for other instructional techniques is the immediate feedback of the appropriateness of the learner's response. Only when he knows how effective he has been can he develop confidence or take other action in future situations. The knowledge that one's response has been correct can serve as a reward, which reinforces that behavior. On the other hand, knowing that one's response is incorrect tends to extinguish it in future situations.

Statement of Objectives

A precise statement of objectives can serve an important function for both the learner and the teacher. It lets the learner know exactly what is expected of him. Too often students fail to perform well because they do not know what they are supposed to do. If they have a clear understanding of these goals, they frequently make great strides toward achieving them on their own. For the teacher, a precise statement of desired student behavior defines what he will teach, what he will evaluate and, in some cases, how he will teach.

The mutual understanding of goals (in terms of student behavior) between learner and teacher can do much to facilitate instruction. Knowing what one is striving for can serve to motivate a student to achieve that end. Pacing the rate of learning can be better gauged when the complete task is known. One can begin to individualize instruction by setting different goals and/or different time schedules for each student, based on individual potential and present ability.

Mosston, in his development of a spectrum of teaching styles, has suggested a method of instruction known as "teaching by task." [1] The task is a precise statement of behavior which the student strives to achieve. These tasks are presented to the students in many ways (check lists, progression charts, demonstrations, films, etc.). Once the student understands the task, he is given a degree of freedom to work at his own rate in his own way. This frees the teacher to provide individual or small group assistance, evaluate students, and make adjustments in tasks based on encountered problems. Tasks may be established for an entire class, for ability groups within a class, or for individuals. This may be evaluated on a quantitative basis (number of tasks or number of repetitions of a task completed) or a qualitative basis (form of execution). The implications that this technique has for efficient use of equipment and facilities, maximum participation, and evaluation are numerous. The key, however, to the effective use of this style of teaching is the precise statement of the tasks in terms of student behavior.

Another way of stating objectives is in question form. The correct answer to a given question can be the desired behavior of the student. A technique that has been used quite successfully over the past years by teachers and authors of instructional materials has been the "guiding question" technique. However, it has only been recently that such questions have been phrased in sufficiently precise terms to enable the learner to interpret exactly what is expected of him.

A conventional text can be converted into a form of a program by this technique and administered so that the student may be motivated to learn. After a careful analysis of the content of a selected text, a teacher should be able to construct a series of specific questions which can guide the student in his study of the material. With these in hand, the learner can extract the material necessary to answer the questions. This does not necessarily mean that the exact answer to all the questions will be stated in the book, but the information given, when analyzed, applied, and synthesized, should enable the learner to respond. Additional learning experiences in the class may be used to assist him in doing this.

[1] Mosston, Muska. *Teaching Physical Education, From Command To Discovery*. Columbus: Charles E. Merrill, Inc., 1966.

Evaluation

Besides preparing the guiding questions, it is necessary for the instructor to develop an item of evaluation for each one of these. When the objectives (guiding questions) and evaluation items (test) are in harmony, there is every reason to expect a high degree of achievement by the student. One way of administering the test to encourage learning is to establish a criterion score for success (e.g., 90%). If he does not reach this score, he *does not fail*. Instead, he is given another opportunity to take the test or an equivalent form of it. Reaching the criterion score on this trial is rewarded by the next highest grade (e.g., B); if not, another trial is given. This procedure may be continued until all students pass the test. If time permits, special learning experiences may be provided in areas where individuals seem to be having continual difficulty. The use of this technique has resulted in a high level of performance on examinations by students. The emphasis is on *learning*, not on failing.

Feedback of Results

The provision of immediate feedback can be accomplished in a number of ways. One technological device designed to do this, which has been a direct result of programed instruction, is the mass responding systems. Material is presented via any number of conventional methods such as lecture, film, television, or similar media. At strategic points throughout the presentation, a question is presented which requires the selection of a response from alternatives (e.g., multiple choice, true-false, rearrangement, etc.). This is usually presented by a visual means such as a transparency or slide. Each student is equipped with an individual responding unit which enables him to signify the answer he selects. In addition, provision is made for the teacher to immediately evaluate how successful the group has been in answering the question. Guided by this feedback, the instructor can continue his presentation or branch off into further explanation of the concept. Elaborate electronic systems have been devised to communicate and evaluate the student's response so that the teacher can continuously diagnose problems and provide assistance when needed, rather than waiting for the results of some future test. The main deterrent to popular use of mass responding systems have been the expense of the electronic equipment, the lack of materials (software) to use with them, and the detailed planning necessary if the right question is to be asked of the right students at the right time.

While such equipment is convenient and desirable, it is possible to conduct a "programed lecture," as it is sometimes referred to, with very simple response mechanisms. Color cards corresponding to various answer choices can be displayed by each student. A visual perusal by the teacher can give him a good indication as to how well the total class did on a given item. The important thing in this technique is *continuous involvement* of *all* students, providing immediate feedback of the results to them, and indicating to the teacher how successful he is in communicating his ideas.

Still another way of providing this immediate feedback is through testing. One of the first teaching machines was developed to be a testing machine (see Chapter One, page 3). The mass responder discussed previously is one way of doing this. A teaching machine which can record incorrect responses made in a program is another way. A simple device for recording answers and providing immediate feedback to the student is a punch board. Any selected response test, such as a multiple-choice or true-false test, may be used. The student punches his choice of answers in the appropriate hole on the board. If the punch goes all the way through, he knows he has the correct answer; if not, he tries again until he succeeds. Before leaving a question, he knows the answer.

There are several different answer cards to which tests may be keyed. The appropriate key is inserted in the board under an answer sheet. Punches are recorded on this sheet. Besides telling the student immediately whether or not his answer is correct, it provides the teacher with a ready-marked examination.

The previous two techniques of providing immediate feedback of results to the learner work well for classroom learning but are of little value during the performance of physical activity. Providing feedback of the results of one's motor performance is more difficult to accomplish. Under an ideal situation, where one instructor can observe and criticize one performer, learning can proceed at an optimal rate. Seldom is the teacher-pupil ratio ever small enough to make this type of instruction feasible. However, it is possible to extend, in part, the skill of the teacher to the student so that he can observe and judge the performance of a classmate. The buddy system in swimming and the idea of students as spotters in gymnastics have been used for years. The training of squad leaders as assistant teachers is also nothing new. The use of every student in the class to evaluate and provide feedback to another student, however, has been used only rarely and seldom in a highly effective manner. Mosston describes this style of teaching as reciprocal teaching and suggests certain conditions to improve its effectiveness. Rather than just telling the partner what to look for, he should be provided with a card on which the specific points of the movements are listed, described, and/or illustrated. This makes it possible to check each part of the performance against the card. The card may be set up as a task sheet, described earlier, on which the observer may check off tasks completed (quantitative evaluation), determine how well they were performed (qualitative evaluation), and even offer comments or suggestions to help the learner improve his performance. The card thus serves as an extension of the teacher himself. The teacher, being free, is able to move about the class and provide individual assistance. It is important, however, that the assistance be directed to the observer, not the performer. When the learner receives the feedback directly from the teacher, he tends to lose confidence in his partner. The observer, likewise, loses his confidence and ability to perform his job, thus negating the advantage of this style.

Modern technology has given us still another means of providing feedback to the performer of a motor skill—television. For years coaches have been filming games and analyzing them with their players. This has been done to a lesser degree in physical education classes. With the advent of the video tape recorder, however, the capability to provide this visual feedback immediately after performance has been brought within the reach of many educational institutions. Most of us are familiar with this concept through viewing "instant replays" on televised sports events.

The same idea is being used in instruction. A student being taught a particular skill can be taped while attempting to perform. Immediately following this it can be played back to him for observation. The instructor may observe the performance with him and add his comments. Such a technique provides strong feedback as well as motivation for the performer.

The foregoing techniques of instruction are examples of how programed instruction has affected the teaching act. Programed instruction as we know it may change considerably over the next decade when the results of research and experience have been evaluated. However, the implications that it has had and will probably continue to have on instructional practice is, and will be, significant.

7

The Challenge of Programing to Teachers

ROBERT CLAYTON AND CYRUS MAYSHARK

Before beginning to write any type of program, the teacher must be firmly convinced that this approach will greatly benefit the students. Unless he has decided that programing is absolutely necessary to accomplish the task, the project will be less than successful. A poor program can be written in a comparatively short time—and it will teach. The results, however, will be far short of satisfying the teacher and the students, and probably cause both to take a dim view of other programs which are, in fact, very worthwhile.

Another essential starting point is preliminary reading about programing. Do not begin reading with preconceived notions about the form of programing to be undertaken. Instead, read about both branching and linear types. Find out what other programs have been done in the area, and decide if this approach is suitable. Read to see what is particularly useful to you in your situation.

Background reading and personal conviction about the worth of programing are the two essential starting points. However, experience suggests that the following specific steps in program writing be noted before the actually beginning the program.

1. *Selecting the unit to be programed.* Ordinarily, the material to be taught is divided into units. On the surface, it would be logical to program the first unit and then do the remainder as the year progresses. However, selection of the unit to be programed should depend more on other factors than on its chronological presentation to the class. Not all units are suitable for programing; some may be too long or too simple, or they may call for special knowledge beyond that of the teacher. Some may be taught in such a manner so as to preclude programing, or may appear so early in the year that satisfactory programing cannot be done.

2. *Analyzing the tasks to be programed.* Once the unit has been selected, the next step is to analyze the tasks involved. A good way to begin this analysis is to examine closely all the steps (or processes) which the student must go through in order to achieve the desired behavior (or product).

3. *Analyzing the students.* It is discouraging to put much time and effort into programing and then find that the students did not need it. This comes about when the programer plunges into the project without taking a perceptive look at the students. How much do they already know about the material? How much natural interest do they already have concerning the subject? The programer must make assumptions about their vocabulary level, their age, their intelligence, their motivation. Examining the students before the project starts will make the next steps easier.

4. *Constructing behavioral objectives.* The rationale behind behaviorial objectives was presented in Chapter 2. Specific examples of these were given and, hopefully, were easily identified. Writing good behavioral objectives seems to take an inordinate amount of time, and there is a temptation to "finish it later." But because it forces the teacher to think very precisely about what it is that should be done by the student, time spent in this stage will, in the long run, be well worth it.

Objectives must spell out exactly what is expected of the learner—the particular thing he must do, under what conditions he is to do it, and what standard of performance is expected of him. These objectives become the organizational pattern for the program because they indicate the sequence in which material is presented and dictate the emphasis that is needed on each area. They relate closely to the task analysis mentioned above.

5. *Constructing a criterion test.* An overlooked step by the inexperienced programer has to do with the construction of an evaluation device. Before writing a frame or paragraph, the exact behavior expected of the student should be known and an examination which will show this should be constructed. Hopefully, a previous test will be suitable. Experience has shown, however, that after constructing behavioral objectives, most of the questions given before do not adequately measure the desired terminal behavior. If at all possible, it would be advisable to administer this criterion exam to a current class that has not received programed material. The primary advantage will be to give the teacher a guide which later will indicate whether his programing efforts have been fruitful or fruitless.

A final word concerning behavioral objectives and criterion tests. Teachers invariably plead "not enough time" as their defense for eliminating these time-consuming steps. The sad fact is that both *must* be done before they will be satisfied with the program. A series of frames or paragraphs can initially be constructed without these steps, but in order to see if the work has been efficacious, one has to know exactly what the students were to learn and then see if they have learned it. Without these steps one is in the unenviable position of having spent considerable personal and student time and energy without being able to see if it has been worthwhile.

6. *Constructing the frames or concepts.* One of the chief causes of programs that are boring is that the majority of the frames or concepts

seem to be written in exactly the same pattern. Beginning programers should have read enough to understand that frames or concepts can be of one of four types:

a. *Teaching,* wherein a new fact or concept is presented for the first time.

b. *Practice,* wherein a previously given fact or concept is viewed by the learner from another angle.

c. *Criterion,* wherein some type of evaluative statement and/or question is presented.

d. *Review,* wherein the material is repeated in a slightly different manner.

In addition, programers must know something about "prompting"—a technique in which the learner is given a hint concerning the correct answer. Cueing and fading are also techniques which are inherent in all good programs. This chapter makes no attempt to teach these techniques, but it does show that programing is not merely separating a body of material into frames or concepts.

Writing a Linear Program

Specific techniques or methods for writing the program vary among different writers. One recommended procedure is to construct one-sentence statements of fact concerning an objective, and write each on a 4x6 index card. Arrange these statements into a logical sequence, using the objectives as a guide. Then, using the same card, rewrite the statement, making it conform to the style to be used in the frames. Cross out or cut off the original statement, and construct the question and correct answer in the space below the revised statement. Add frames which will cue, fade, provide progression, or review. It is helpful to have two or three naive students read and comment on the program before continuing.

The above method may seem somewhat arbitrary, and by no means should be considered the only technique for constructing a frame, but it has been tested and found helpful by the authors. Index cards are preferable because of the practical problem of arranging the sequence of frames. It might be thought that once the frames are written, the test is done. This is possible, but reflective thinking by the programer at a later time may cause many changes in the complete frame.

The importance of testing frames with two or three naive readers cannot be overemphasized. The best readers are those who naturally ask questions in class, and are not satisfied with incomplete or vague answers. These students are sometimes hard to find, but are valuable to the programer. During the early readings their questions will quickly point out overlooked or misleading terms, or one of several other possible omissions. Oral questioning by the teacher at the completion of their reading will provide a quick check to determine the extent of their learning.

Revising the initial draft now begins. The following specific actions could be taken: (a) permanently number the frames; (b) duplicate the complete program in the most suitable form (which is usually some form of text); (c) let a class use it (they should not only study it, but also mark errors or ambiguous parts); (d) administer the criterion examination; and (e) note errors and other student remarks on one master copy.

In this first complete draft, duplicate only enough copies for the classes to use. There will be so many changes that extra copies will be useless. Stencils or dittos can be used very well in this initial process, but dittos have the added advantage of being easily cut apart, rearranged, and renumbered for the next draft. In evaluating the work, look first at the results of the examination. This will quickly reveal if the material has been written reasonably well, or if a new start will have to be made. It is of paramount importance that students return their text, because this is the only way that their comments can be noted.

By this time most of the large errors will have been eliminated. In some cases the procedure above might be repeated, but this depends on how the students have performed on the criterion examination.

Writing a Branch Program

> The pupil-tutor relationship was the model for the auto-instructional technique known as intrinsic programing. The characteristic feature of the pupil-tutor relationship is interaction. The pupil responds to what the tutor does, and the tutor responds to what the pupil does. The major structural features of intrinsically programed material are designed to permit the same sort of interaction without a live tutor; the rationale of the method derives from the fact that the necessary two-way responsiveness can be achieved with straightforward, practical devices.[1]

As seen in Chapter 2, the format of branch programing is a series of interconnected paragraphs, each followed by a question with two or more answers. The student selects what he believes to be the correct answer and turns to the page number indicated by that answer. If his choice is the correct one, the page he comes to will endorse his choice and contain the next paragraph with its question and multiple-answers. If his choice is one of the incorrect alternatives, the page he reads will inform him of his error, contain an additional paragraph or two of information, and instruct him to return to the original question to try again. Thus, the basic intrinsic programing technique is the inclusion of multiple-choice questions in expository text and the use of these questions to: (a) check on the student's progress (diagnostic); and (b) provide additional information as it is needed (remedial).

The three major diagnostic uses of the multiple-choice question and the answer alternatives are: (a) to diagnose a remedial need for basic or background information; (b) to diagnose a failure in communication of a misunderstanding of the concept; and (c) to detect the student who is skimming or guessing. Obviously, each question and its accompanying

[1] Walther, R. E., and N. A. Crowder. *Techniques in Intrinsic Programing.* Silver Spring, Maryland: U.S. Industries, Inc., 1965, pp. 1-2.

alternatives need not perform all three of these diagnostic functions. It is important, however, that at least one alternative of each frame or concept be intended to test the communication of the material and the extent of the student's misunderstanding. Each alternative certainly should be challenging to the student and function as an effective foil.

The mechanical aspects of writing a branch program may be summarized under four headings: (a) the multiple-choice questions; (b) the right-answer page; (c) the wrong-answer page; and (d) scrambling the program. In summary form, the important steps under each of these headings are as follows:

Multiple-Choice Questions

A. Place expository material, the question, and its accompanying alternatives on a single sheet of paper. As with linear programing, a half sheet (of 8½ x 11) is preferable, but a full sheet may be necessary if the expository material is two or three paragraphs in length.

B. The multiple-choice question should:

1. be in the direct form of a question.
2. test on the central issue or idea.
3. not be deceptive (avoid words such as "always," "never," or "possibly".
4. seek information previously given in introductory or expository material. Guessing must not be a part of the program.
5. be within the student's level of aspiration (i.e.—not be too hard nor too easy; the chance for failure is always present and challenges the student to extend himself).

C. The alternatives (at least three) may be in any form (sentences, phrases, clauses, single words, letters, numbers, formulas, or pictures) appropriate to the question asked.

D. Several principles of stem and alternative construction need to be kept in mind. It is important to remember that each stem should test only one concept at a time, include all words which are common to all the alternatives, and be stated in positive terms. Equally important, the alternatives should be logically consistent with the stem, be grammatically consistent with the stem, be similar to each other in length, content, and grammar, be as brief as possible, and be plausible.

E. Finally, each multiple-choice question should test the students' ability to use new knowledge.

Right-Answer Page

The branch programed material in Chapter 2 was organized in paragraph rather than page form to conserve space. A portion of this material is excerpted and altered to provide examples of right (and wrong) answer pages here. Figure 1 provides an example for the following summary points of a right-answer page.

A. Each page is numbered consecutively and the parenthetical statement "(from page—)" is shown below this to keep the student oriented.

B. The alternative selected by the student is repeated, preceded by the words "YOUR ANSWER" in bold type.

C. This paragraph begins with the words "You are correct" and is followed by one or more sentences that summarize why the chosen alternative is correct, comments on the other answer alternatives, and builds a bridge to the next new concept.

D. The next element of the right-answer page is a series of paragraphs (1-3) that introduce the next concept in a concise but informal manner. It is in the tone of this expository material that the programer strives to establish and maintain a warm personal relationship between the student and his "tutor."

(A)

18
(from page 13)

(B) **YOUR ANSWER:** Tutoring

(C) You are correct. The branching technique is an effort to use the tutorial system on paper. Tutors continually ask questions, with each following question based on the answer to the previous one.

(D) The intrinsic means "within," and is often used to describe branching programs. An intrinsic program is one in which each answer to a diagnostic question determines the exact route taken by the learner. In other words, the programer does not determine the next paragraph that will be read by the student, the program contains within itself several alternate branches.

(E) Which is the *best* description of an intrinsic program?

a. Based on the knowledge within himself, the student determines what paragraph he will read next. (page 25)

b. The correct answer to each question is found somewhere within the paragraph. (page 19)

c. Each paragraph provides an opportunity for the learner to measure the knowledge within himself before he goes on to the new segment of information. (page 22)

Figure 1. Sample right-answer page.

E. The last element of the right-answer page is the multiple-choice question and its answer alternatives.

Wrong-Answer Page

Figure 2 provides an illustration, based on material in Chapter 2, of the format for the wrong-answer page.

A. The pagination for the wrong-answer page is similar to that of the right-answer page.

B. The alternative selected by the student is repeated, preceded by the words "YOUR ANSWER" in bold type.

(A)	19 (from page 18)
(B)	**YOUR ANSWER:** The correct answer to each question is found somewhere within the paragraph.
(C)	This statement is generally true, but this isn't the best answer to the question.
(D)	The main distinction of an intrinsic program is that it lets the learner *use* the knowledge within himself to determine his next step. This answer says nothing about this inner direction, and merely indicates that the correct answer is present. Also, this statement could describe a linear program just as well.
(E)	Return to page 18.

Figure 2. Sample wrong-answer page.

C. The first sentence of the paragraph should clearly indicate that the student's choice was incorrect. There is no recommended format for this except that the wording should be tailored to the degree of error made by the student. In admonishing the student, the programer must always assume that the student made a sincere effort, and sarcasm of any sort ("That was a silly choice") should not be used. Correction must be firm without being antagonistic. The remainder of the section should indicate why the selected alternative is incorrect.

D. This element of the wrong-answer page is devoted to a further explanation of why the selected alternative is incorrect and a further explanation of the concept so the student may be better able to select the correct response. Additional information bearing on the topic is certainly appropriate here, but the programer must exercise caution not to provide the correct answer.

E. The final element on the wrong-answer page is to return the student to the right-answer page from which the wrong answer was selected.

Scrambling the Program

A. Unlike the examples in Figures 1 and 2, which assume the prior event of scrambling, it is easier to number the pages consecutively when actually writing a branch program. Thus, page 1 would contain the introductory paragraphs to the unit being programed and the first multiple-choice question with its alternatives. If there were three alternatives, pages two and three would be the wrong-answer pages and four would be the right-answer page. This order would be followed throughout the entire program and is done with regard to the arrangement order of the answer alternatives on the right-answer page. Once completed, it is then necessary to rearrange the order of the program pages and assign new sequential page numbers.

B. The first page of a branch program should be an odd number, thus appearing on the right-hand side of the open book format. The last page of the program should be the highest page number in the scrambling process.

C. Alternatives should be placed no more than 7-9 pages before or 7-9 pages after the related question.

D. To reduce the confusion of shuffling the manuscript physically, a bubble diagram (Figure 3) and a pagination check sheet (Figure 4) are used. The bubble diagram is a flow chart showing the main and branch paths through the program. The pagination check sheet provides a running record of the pages used and the pages still available.

E. The process of scrambling is accomplished by the following steps:

1. Determine the number of pages in the manuscript and know that the number of scrambled pages will be the same.
2. Draw a line under the number on the pagination page corresponding to the number of pages in the manuscript and cross out all the numbers higher than this. The remaining numbers are available for scrambling.
3. Place the number 1 in the first bubble, place number 1 in the upper right corner of the first page of the manuscript, and cross out number 1 on the pagination page.
4. Assign a number from 2 to 10 to the correct answer alternative (the number 6 is used for purposes of example) and place that number in the second bubble of the bubble diagram, after this alternative on the first page of the manuscript, and in the upper right corner of the manuscript right-answer page. Do not forget to slash through the number on the pagination page.
5. The wrong answers are handled next. If, in the example above, the correct answer was the second of three alternatives, the first alternative (a wrong answer) should be assigned a page number less than 6 and the third alternative (the other wrong answer) should be

Figure 3. Bubble diagram.

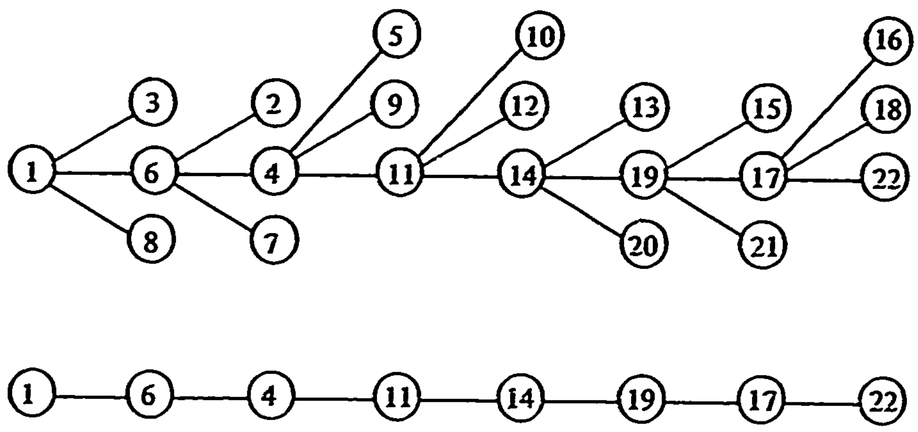

Figure 4. Pagination check sheet.

	~~10~~	~~20~~	~~30~~
~~1~~	~~11~~	~~21~~	~~31~~
~~2~~	~~12~~	~~22~~	~~32~~
~~3~~	~~13~~	~~23~~	~~33~~
~~4~~	~~14~~	~~24~~	~~34~~
~~5~~	~~15~~	~~25~~	*etc.*
~~6~~	~~16~~	~~26~~	
~~7~~	~~17~~	~~27~~	
~~8~~	~~18~~	~~28~~	
~~9~~	~~19~~	~~29~~	

assigned a page number greater than 6 (but not more than 7-9 pages removed from page 1). A bubble is then drawn above the bubble representing page 6 (for the page less than 6 for one wrong-answer alternative) and a second bubble is drawn below (for the page greater than 6 for the other wrong-answer alternative). As seen in Figure 3 the pages selected for this example are 3 and 8 respectively. These assigned page numbers are then placed in the upper right corners of the appropriate wrong-answer alternative pages and after each corresponding wrong-answer alternative on the multiple-choice question page. The same page numbers are also crossed out on the pagination check sheet.

6. The next question is on page 6, the right-answer page to the previous question. The alternatives are numbered in a corresponding manner and this procedure continues through the entire program. Remember that the highest page number should be the last right answer in your program sequence. Care must be taken not to place an alternative facing either its corresponding question page nor facing the right-answer page. Figures 3 and 4 simulate a completed program begun in the partial description above.

Partial Solutions to Recurring Problems

Practical problems which arise when writing a program have to do primarily with time, evaluation, and money. Perhaps the main problem is time. When trying to program a unit just prior to teaching it, the teacher must be realistic in his goals. It is possible to take one or two of the objectives and finish them for use in a few weeks, or to take one of the units taught in January and start working on it the previous September. What causes this time problem? It is simply that an inexperienced programer seems to be able to write only five or six good frames or concepts in an hour. This seems like an atrociously low figure, but the problem of writing so that *everyone* can get the same meaning from the work takes much longer than expected. One attack on this problem is to use large blocks of time (2-3 hours) rather than an hour here and an hour there. The first hour of work seems to be nothing more than revising the material written previously and refocusing attention on the desired progression. Another solution for some is to use a tape recorder or dictaphone. Dictating the frame statements only (not the question or answer) seems to speed things greatly. After the statements are typed on half-sheets of paper, re-read them and then add the question-and-answer part of the frame. This method takes practice but it is worth mastering.

Another problem has to do with evaluation. No matter how good or poor his work is, the beginning programer will be rather pleased with it and the students will probably concur. However, it is wise to provide for anonymous evaluation conducted by someone who did not write the program—preferably a fellow teacher who is skeptical of the programer's efforts. Students will generally give an honest opinion when they are asked for anonymous comments, but even these comments must be evaluated in the light of the results.

The cost of reproducing material in rough draft form is greatly underestimated by the beginner. It takes much paper and ditto masters or stencils to reproduce even one objective. By far the best approach is to have the administrator obtain a small grant for supplies. This is a logical use of school funds and usually meets with quick approval. If this cannot be done, it is possible that a small donation by each student for their "text" will cover the bulk of the cost.

Two problems are common to beginning programers. First, they tend to write frames that are too long or complicated. The frames appear quite good when first written, but this is because they already know the point to be made. Once a naive student starts to read the rough draft, however, it soon becomes apparent that more frames must be added. Secondly, a beginner tries to follow all the rules set up by the experts and ends up with a dry, boring presentation of facts. By and large, the rule seems to be that any type of wording or any technique is acceptable if it works. Branching has been done in linear programs by having students skip frames, even though Skinner doesn't do this. Pretests have been given so that students can begin where they need to. Thought questions (without an answer being given) have been used. Consider these techniques and make a constant effort to write in a conversational tone, spaced with humor when appropriate. It is hard for a student to study a boring presentation—or have you forgotten some of the texts assigned to you in earlier years?

8

Summary

CYRUS MAYSHARK

The previous seven chapters have covered a plethora of material and at this point the reader should be reasonably well versed in the *applications* of programed instruction to health education and physical education. The task that falls to this final, brief chapter is to identify the *implications* of programed instruction for these professions.

Further Research

Specifically, the research that is still needed in programed instruction falls under three categories. The first concerns itself with the program paradigm. This has to do with the writer's style and format used in the construction of a program. In this booklet the two basic paradigms, linear and intrinsic, have been discussed. Undoubtedly, there are several other ways of presenting a program which have not yet been explored. At the present time, there seems to exist a state of stagnation concerning the evolution of new program formats. Many of the programs existing today, especially those of the linear type, leave much to be desired as far as presenting the material to be learned is concerned. Flexibility and originality are always present with the growth of a new endeavor. A static state in the construction of new program formats would be a deadly weapon to the advancement of programed instruction.

The programer has a responsibility to avoid boring the learner with factual information presented in a monotonous way. Although it is extremely difficult to write bits of information in an interesting way, it is not impossible. It is expected that the student will be motivated by the program to the extent that he will continue through the program and even go beyond what is required by the instructor. Unfortunately, many of the existing programs do not have this feature. The reason for this is probably because the art of program writing is so new. Through research, new and exciting programs can be created and tested, thus advancing the programed-learning movement.

A second category of needed research centers around the question of what material should be programed. Considerable research has demonstrated that programed instruction has much to contribute to the learning process. Although the theory behind programed instruction is psychologically sound, it will not be successful unless applied in the proper way with subject matter that lends itself to programing. What might this subject matter be? The answer to this can be found in the testing of hypotheses derived from a complete analysis of a subject. It is unwise to assume that because programed instruction has been used with success in certain subject areas, it naturally would be successful in all areas. This is not the case. It is necessary for subject specialists to take a serious look at the potential of programed instruction in their area of specialization. Through intensive examination and analysis of what could and should be programed, researchers can determine the role that programed instruction has in the teaching of a particular discipline.

Thirdly, research is needed concerning the student who uses programed material. What happens to attitudes? It is a known fact that one's psychological state of mind plays a definite role in his ability to learn. If a student possesses an improper attitude toward a teaching method or subject matter, the learning potential is reduced. On the other hand, if the student enjoys the teaching methods as well as the subject being taught, his capacity to learn will be much greater than in a less desirable situation.

In order for programed instruction to withstand the test of time, it will be necessary to determine its effects on the attitudes of learners. Programers need to know how their program affects the attitudes of its users. Answers to questions such as the following will contribute to the development of more effective programs: (a) Do the students enjoy this method of learning? (b) Do they experience a pall effect or boredom? (c) Does the program inspire them to seek further information? (d) Do all learning ability levels appreciate and enjoy this method? (e) Does programed instruction help develop a better outlook toward education? (f) Can it change learning attitudes? These questions and many more need answers before programed instruction can be hailed as a complete success.

Still further, other research is needed in the performance limits of learning. Can this new method of educational technology contribute to one's learning potential? In other words, can it teach more in a shorter period of time than present methods being used? This brings up the question of learning rate. Is it more desirable for the student to be pressured by a time limit or is it better for him to move at his own rate of speed?

Research in programing is in its infancy. Many questions remain and only carefully designed research on many fronts will uncover the answers. Certainly a complete understanding of this educational technique is not going to occur in the immediate future.

Evolution, Not Revolution

Whatever change that takes place under the influence of programed instruction will be accomplished over a substantial period of time, not overnight. Programed instruction—much less its more sophisticated counterpart, computer assisted instruction—will still be foreign to many local school programs even in the late 1970's. At least five factors ensure a gradual or evolutionary adjustment rather than a more rapid or revolutionary upheaval:

(a) Programed materials in specific subject areas are limited. This has certainly been demonstrated in both health education and physical education. The challenge of multiple areas of instruction plus the wide age range of students creates a need for programed material that is literally gigantic. Whether or not sufficient programs of quality are ever produced is certainly problematical, at least with current levels of technique and manpower. In making this point, however, it is recognized that educators of tomorrow will be more skilled in using and developing programed materials for their students than were educators of yesterday.

(b) The technological changes that must accompany full use of programed materials are more expensive than most school systems are prepared to recognize. Traditionally, 75-90 percent of local school budgets have been earmarked for salaries. A change in this fiscal practice to include programed instruction, which really means an expanded total budget since the need for teachers has not yet been lessened, will take considerable time. Most communities are moving slowly in the purchase of the hardware and software so necessary to implement programed instruction.

(c) Real implementation of programed instruction must include structural changes in the school buildings themselves. Our newer buildings, where the architects and local planners have vision, are built for flexibility and change. Unfortunately, the large majority of school buildings, still with long years of "useful" life, are inflexible boxes-within-boxes.

(d) Enthusiasts of programed instruction often promise more than they can demonstrate. When challenged, their failure to achieve full prediction, even though substantial gains are made, subjects programed instruction to unwarranted and unjust criticism.

(e) Those who must implement programed instruction are resisting it with an indifference that is difficult to overcome. Teachers in our public schools remain aloof, to a degree, to the lure of programed instruction. As one writer has phrased it, superintendents, who might otherwise take steps to innovate, are tied by "no-power"; that is, the unified chorus of "no" rising from teachers. This problem may very well be the most difficult to solve, yet with full knowledge of programed instruction and its contribution to the educational scene it is hoped and expected that teachers will react quite differently. When the implications of programed instruction for students and teachers are understood, the apprehension of teachers should be dispelled.

Implications for Students

The one-room school house of a hundred years ago contained students at all levels of chronological age and intellectual capability. As schools with multiple classrooms were developed, it became possible to group students by single grade levels, and for awhile this was viewed as satisfactory. But soon it was realized that even in a single grade (i.e.—the fifth grade in a self-contained classroom) or course (i.e.—biology at the 11th grade level) there were as many levels of achievement as there were students, and the trail blazers of education sought answers to this problem. As seen in Chapter 1, programed instruction dates from Socrates, but in the modern sense was advocated as early as 1920. Today, it is widely accepted as one means of coping with wide differences among individuals even when these occur in the same classroom.

In the extreme, a programed unit on communicable and noncommunicable diseases for the tenth grade or gymnastics for the eighth grade will guide a class of 30 students at 30 different rates of progress to the point where all 30 successfully accomplish the defined *specific* objectives. Where traditional accomplishment is viewed in terms of a *learning* curve, programed instruction features a *time* curve. Some students complete the program in a very short period of time; most take a somewhat longer period; some require still more time. Theoretically, the achievement of the faster students is no greater than that of the slower students. However, the fast students are not bound by the limits of a daily, weekly, or even yearly schedule. They may progress at their own speed but are limited, perhaps, by what is judged to be appropriate socially and chronologically. At the other end of the time curve, the slow students progress through the program with equal learning success and under not only the challenge of self-scrutiny but also the clear knowledge of real accomplishment.

In a practical sense, of course, it must be recognized that if programed instruction actually can replace the learning curve with a time curve, there probably just is not enough time to get some students through any single subject or curriculum. This fact aside, all students *can* learn more in a shorter period of time than has been demonstrated to date, and programed instruction is certainly one method to achieve this improved efficiency and acceleration.

Implications for Teachers

Why do teachers remain aloof to, and even resist, programed instruction? Primarily, because they see it as a threat to their time-honored role as the controller of the learning process. They are made to feel insecure by the claim that programed instruction will teach more students more efficiently than a "live" teacher could teach the equivalent material. While this may be true, and because of it, teachers *should* be threatened. The *real* implications for teachers have been overlooked.

The threat of programed instruction is real only for those teachers who are dispensers of information and nothing more. In that sense they are not teachers in a truly professional manner but, instead, are extremely inconsistent, unpredictable teaching machines.

Teachers generally, and those in health education and physical education especially, are much more than dispensers of information. Teachers are concerned with human beings, with their hopes, aspirations, and dreams—for now and in the future, for themselves, their family, their community, and the whole of society. It is in the difficult realms of attitudes, values, and behaviors that the real teacher functions. Programed instruction promises to free the teacher from his insidious conditioned role of information-purveyor and thus permit him to go about the real task of education—that of humanizing individuals.

We hope this booklet will help teachers to view positively the tremendous changes that will take place in the technology of education in the immediate years ahead. More than this, we hope it will contribute to their becoming tomorrow a better health educator or physical educator than they are today.

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